AF MANUAL 51-44

FIGHTER
and
FIGHTER-BOMBER

EMPLOYMENT IN TACTICAL AIR OPERATIONS

DEPARTMENT OF THE AIR FORCE

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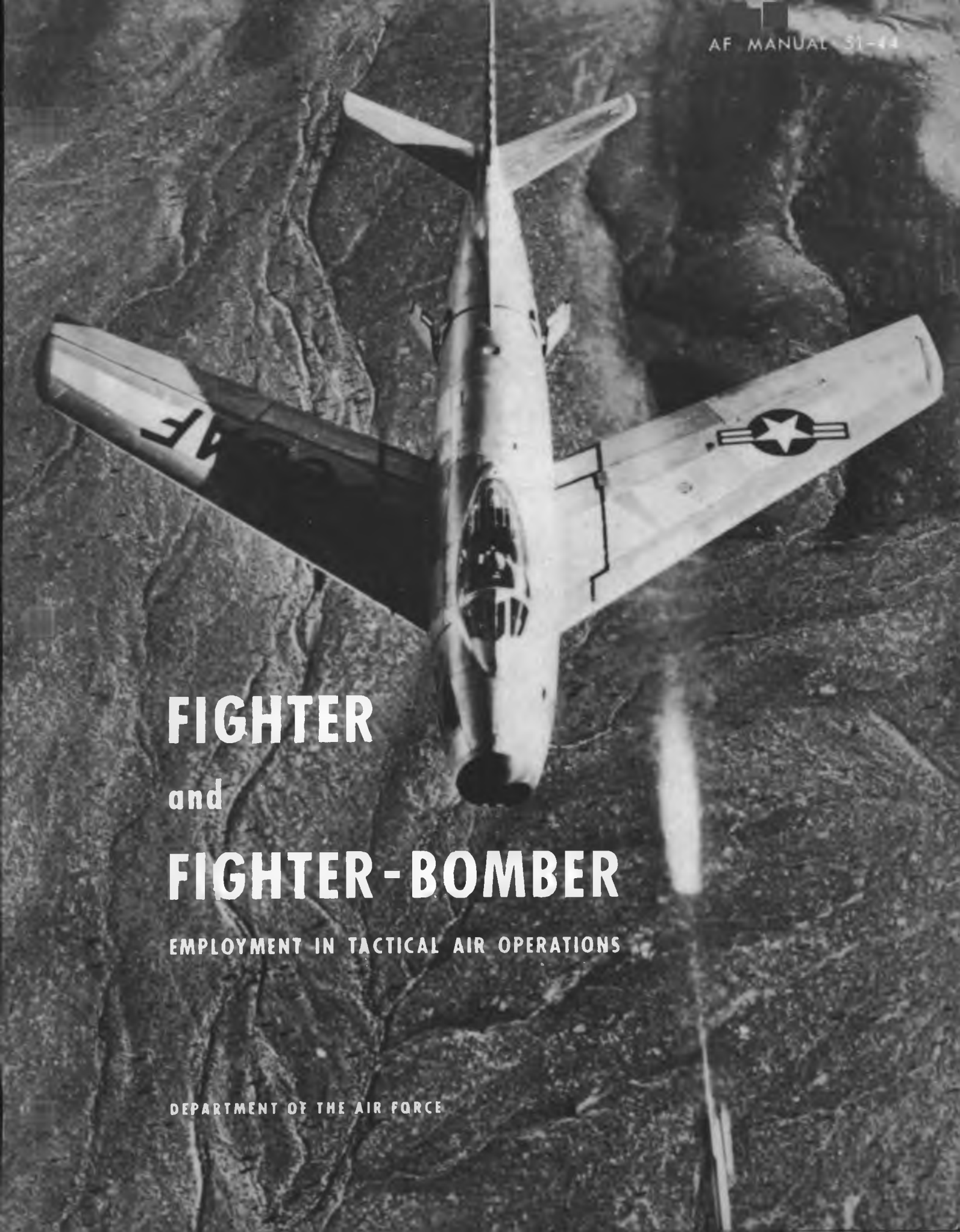

FIGHTER and FIGHTER-BOMBER

EMPLOYMENT IN TACTICAL AIR OPERATIONS

DEPARTMENT OF THE AIR FORCE

AIR FORCE MANUAL
NUMBER 51-44

DEPARTMENT OF THE AIR FORCE
WASHINGTON, D. C. JULY 1953

foreword

1. PURPOSE. The purpose of this Manual is to provide tactical fighter and fighter-bomber pilots with a basic knowledge of operational techniques peculiar to tactical air operations.

2. SCOPE AND CONTENT. This Manual presents the background information on over-all theater air operations required by the tactical fighter or fighter-bomber pilot in the intelligent performance of his duties. It follows this with basic tactics and techniques peculiar to tactical air operations, discussed from the point of view of the fighter or fighter-bomber pilot. Weapons used in tactical air operations are then discussed, with emphasis on proper selection of weapons and fuzing of bombs for the particular type of target being attacked.

3. RECOMMENDATIONS. Recommendations or suggestions for the improvement of this Manual are encouraged. Comments or recommendations should be forwarded through channels to the Director of Training, Headquarters USAF, Washington 25, D. C.

BY ORDER OF THE SECRETARY OF THE AIR FORCE:

N. F. TWINING
Chief of Staff,
United States Air Force

OFFICIAL:
K. E. THIEBAUD
Colonel, USAF
Air Adjutant General

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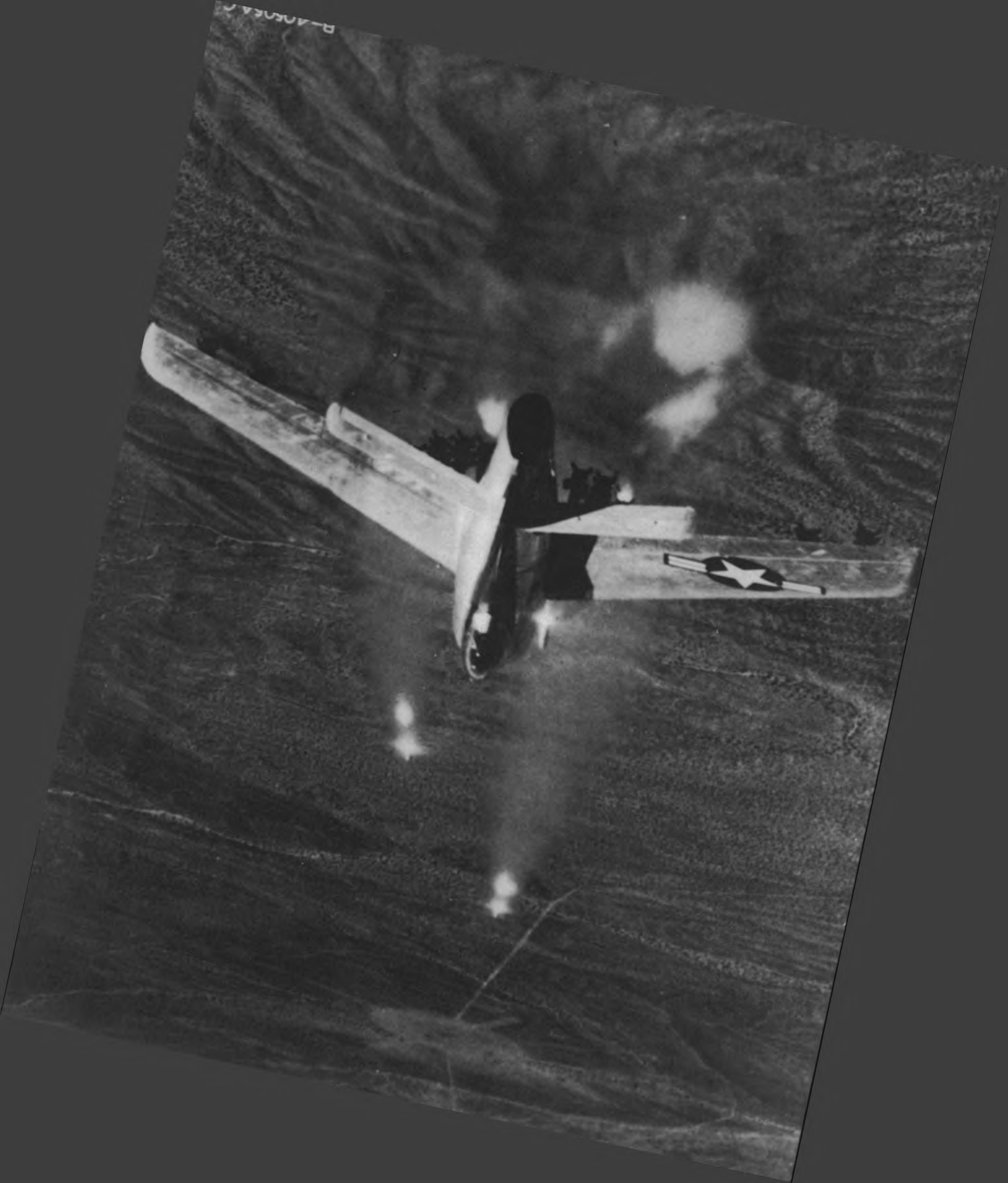
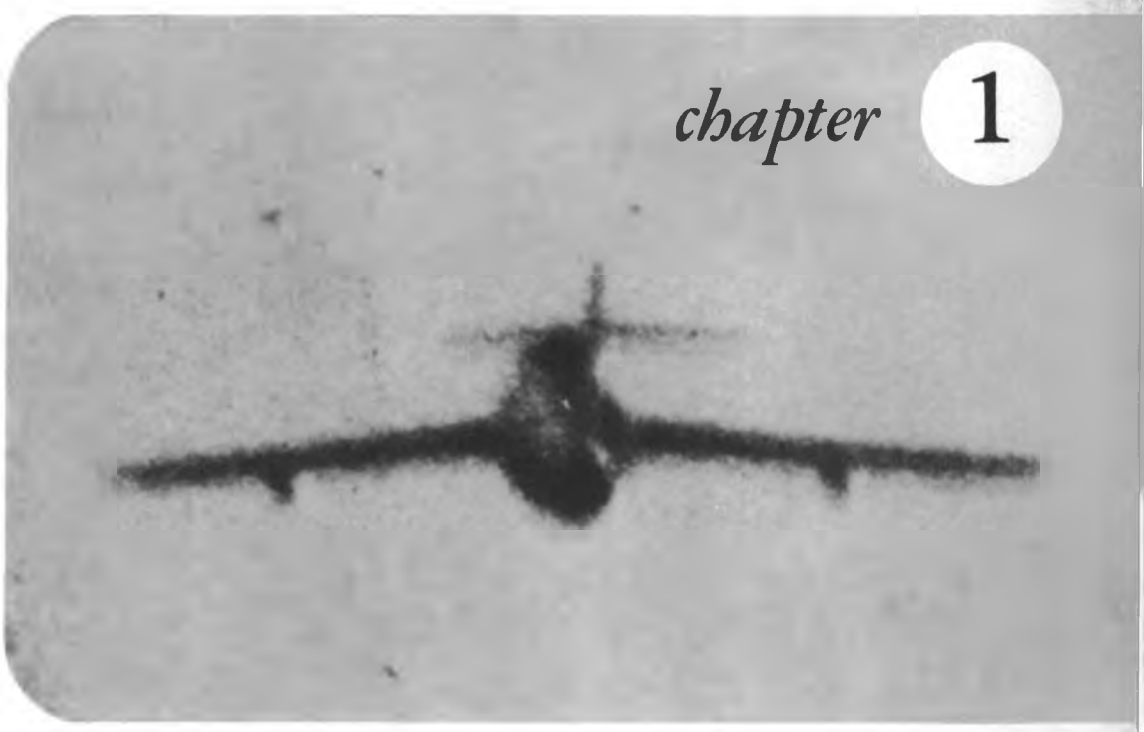
contents





chapter **1**

organization and mission

The purpose of this manual is to provide the tactical fighter and fighter-bomber pilot with a basic knowledge and understanding of operational techniques peculiar to tactical air operations. While it is realized that new aircraft and weapons will change tactics and techniques to a varying degree, there are basic factors that will remain firm regardless of new equipment. The combat-proven tactics and techniques discussed in this manual are intended to provide a uniform concept for the employment of fighter and fighter-bomber aircraft in tactical operations. Certain background material is presented in Chapters 1 and 2 to assist the pilot in his over-all understanding of tactical air operations.

ORGANIZATION OF THEATER AIR FORCES

Organization of theater air forces is predicated on the fundamental principle and doctrine that air forces are an entity and must be employed as such. Their versatility, flexibility, and capacity for concentration are compromised when they are employed in segments for achieving purely local effects. Centralized control of all air forces within the theater is the only way to obtain the maximum benefit of their concentrated fire and shock power. This maximum effect must be obtained by timely attacks in force on those targets offering the greatest return with respect to the over-all theater mission.

Theater air forces under the direct command and control of the theater air commander are normally organized as shown on page 3. As indicated on the chart, a tactical air command may operate independently or may be associated with an army group for the coordination of plans for air-ground operations. Normally, where there are air-ground operations, the subordinate tactical air forces-and field armies are likewise associated for the detailed planning and for the execution of such plans. Detailed organizational charts of tactical wings, groups and squadrons are presented on pages 4 and 5.

MISSION OF TACTICAL FIGHTER AND FIGHTER-BOMBER UNITS

The mission of tactical fighter and fighter-bomber units is to engage in operational missions, as directed by higher echelons within the theater air structure. These operations may be independent of or in conjunction with surface action, but in any event are all directed toward the effective, efficient, and economical accomplishment of the theater commander's assigned mission. Generally speaking, the offensive and defensive efforts of fighter and fighter-bomber units are divided into three principal tasks: counterair, interdiction, and close air support. These various tasks may be performed concurrently or consecutively and emphasis may shift from one to the other, but regardless of the task, command and complete control of theater air forces must be centralized and direction exercised through Air Force channels.

Counter-air Operations

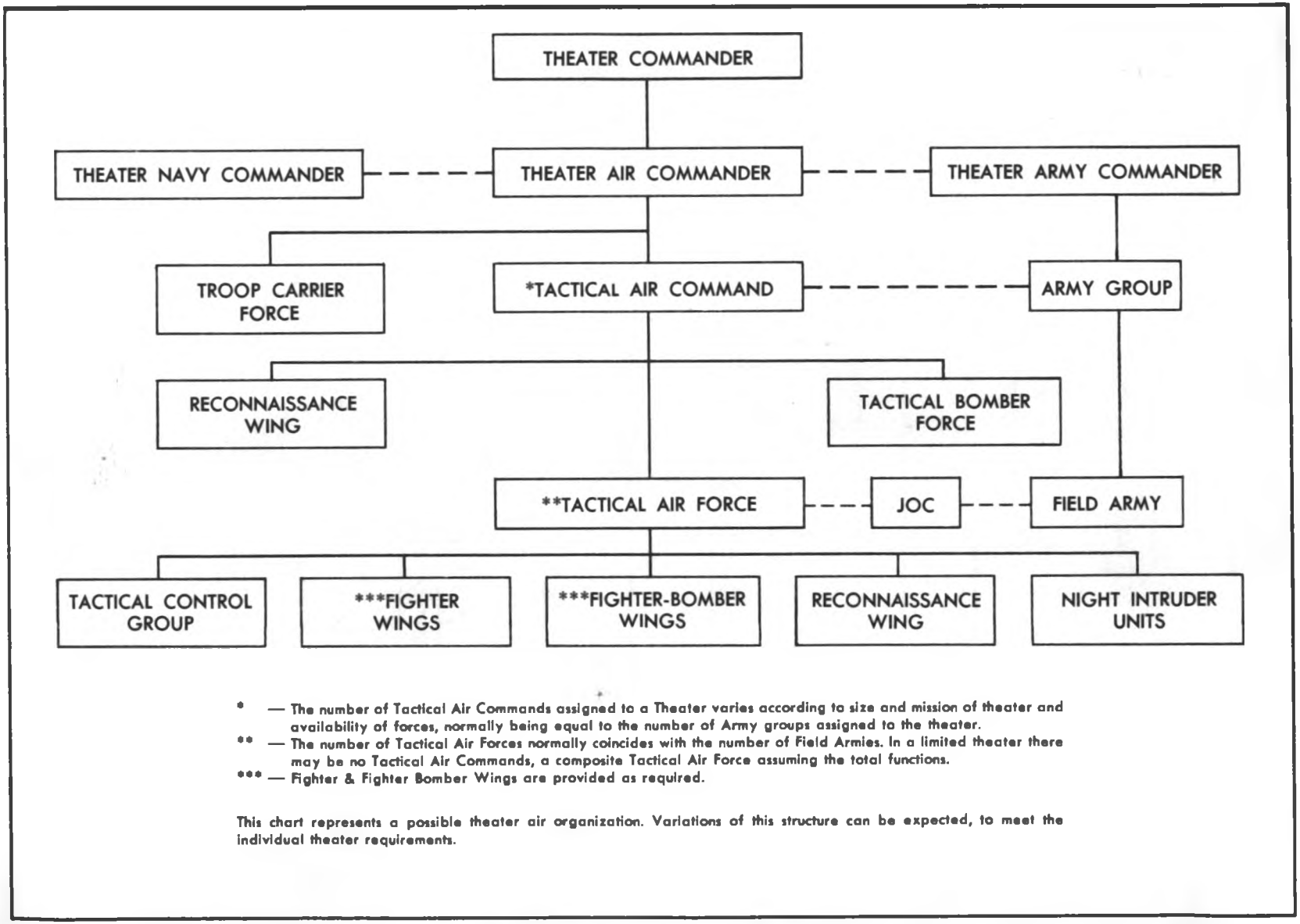
Counterair operations are directed toward gaining and maintaining air superiority. Air superiority is a relative condition but can be said to exist when enemy air forces are no longer capable of effectively interfering with our own air, ground, and sea operations. Achieving the required degree of air superiority is generally the greatest contribution that air forces can make to the theater mission, and justifies the full employment of all suitable resources in counterair operations until an adequate degree of superiority is achieved. Although the vital mission of air defense is included in this task, successful counterair operations are dependent on an aggressive effort by tactical fighters and fighter-bombers continually on the offensive. They must seek out and neutralize or destroy the enemy air capability until the threat of enemy air action against our own forces is removed, or has assumed the proportion of an acceptable "calculated risk."

Counter-air operations must be a well-planned and coordinated effort on the part of the entire theater air force, including the tactical bomber and night intruder elements. Like all tactical air operations, counterair operations are centrally controlled to permit maximum exploitation of the inherent flexibility of theater aircraft.

Once air superiority has been gained, it must be maintained. This indicates that a certain portion of our air effort may have to be devoted continually to counterair operations to prevent the enemy from rejuvenating his air forces and effectively challenging our control of the air.

Interdiction

Interdiction operations are designed to destroy or neutralize the enemy military potential before it can be brought to bear effectively against our own forces, and to restrict the mobility of hostile forces by disrupting



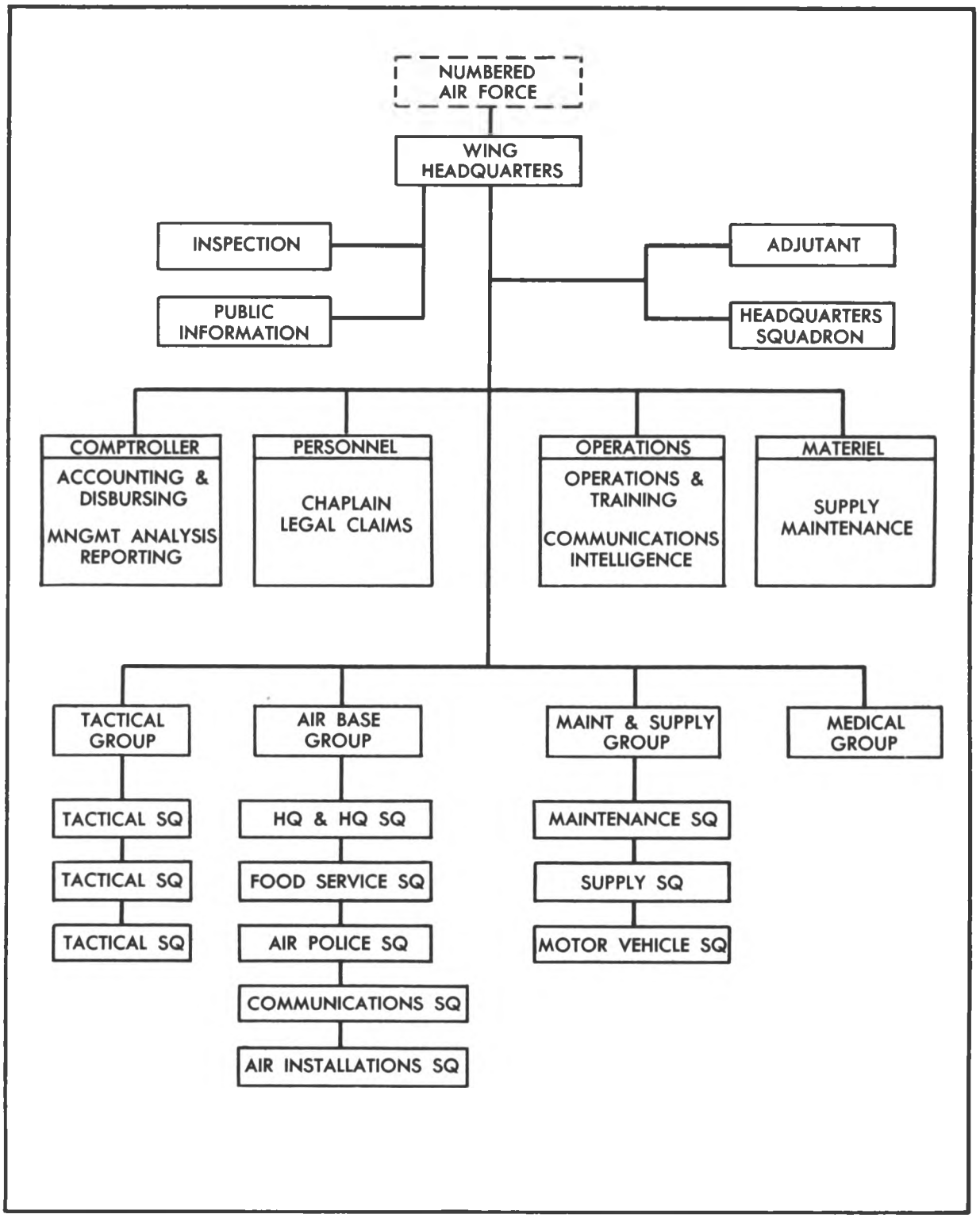
* — The number of Tactical Air Commands assigned to a Theater varies according to size and mission of theater and availability of forces, normally being equal to the number of Army groups assigned to the theater.

** — The number of Tactical Air Forces normally coincides with the number of Field Armies. In a limited theater there may be no Tactical Air Commands, a composite Tactical Air Force assuming the total functions.

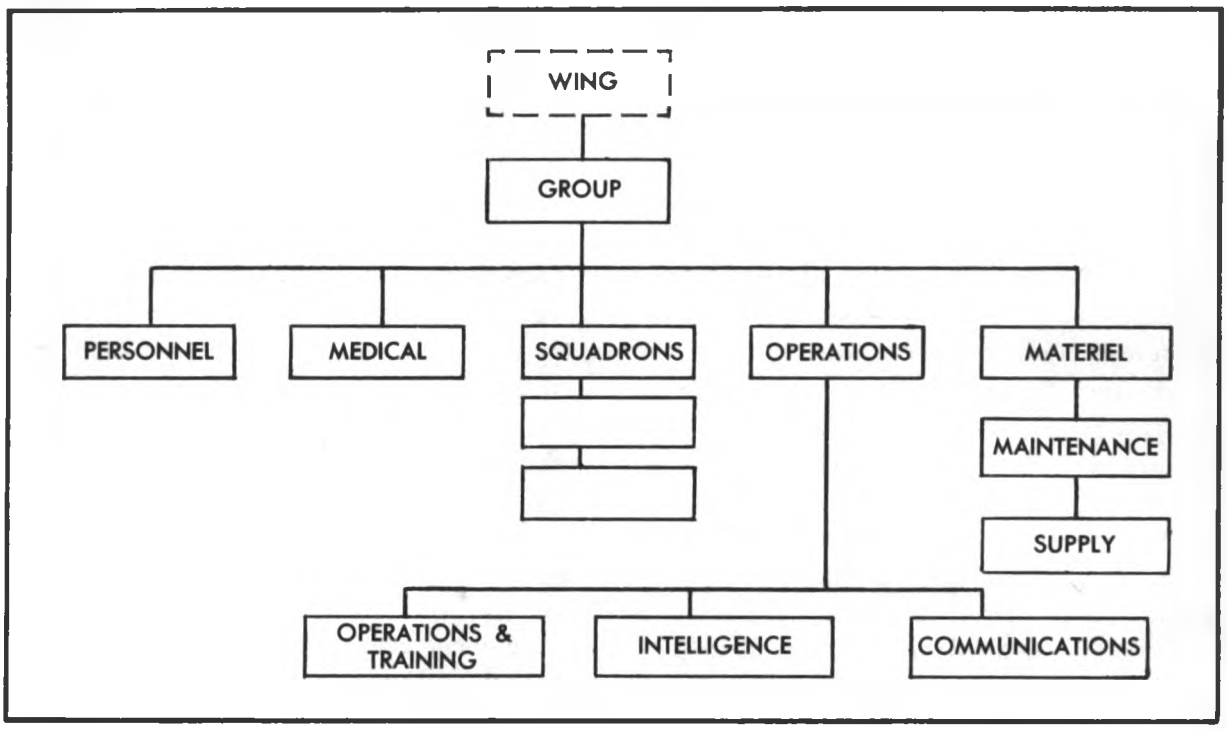
*** — Fighter & Fighter Bomber Wings are provided as required.

This chart represents a possible theater air organization. Variations of this structure can be expected, to meet the individual theater requirements.

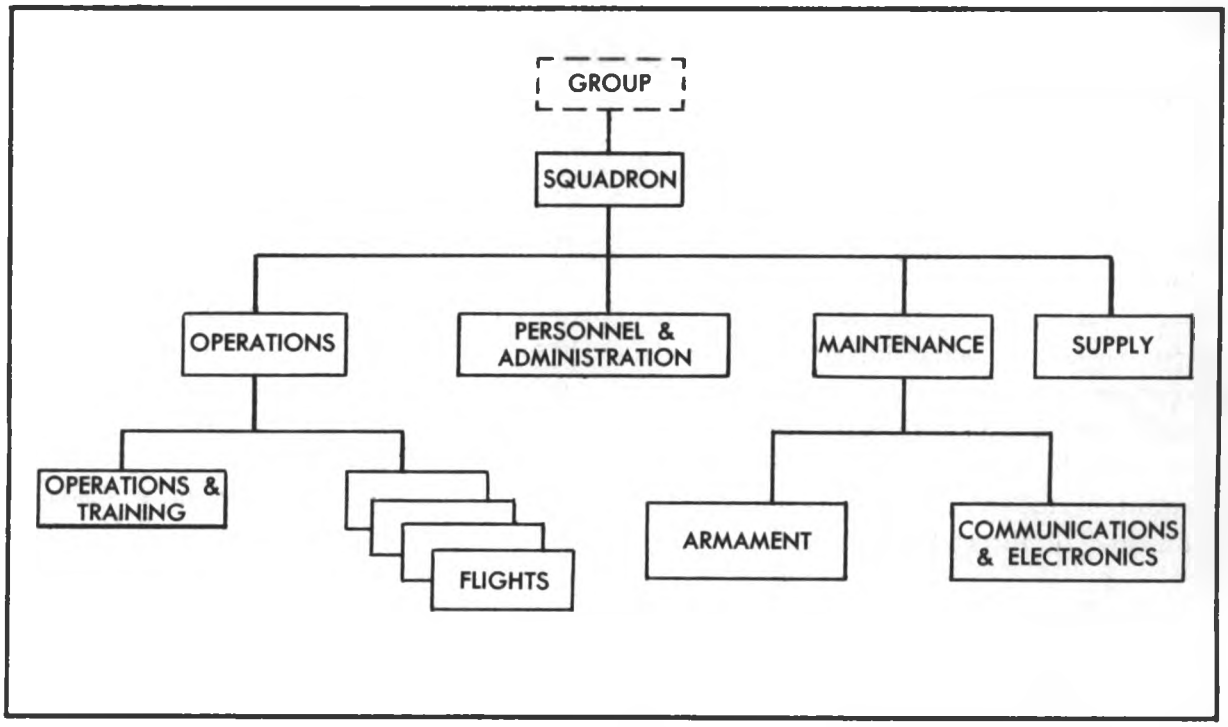
Typical Organization of Theater Air Forces



Organizational Chart of Tactical Wing



Organizational Chart of Tactical Group



Organizational Chart of Tactical Squadron

enemy lines of communication. True interdiction begins deep within the enemy homeland; weapons are most vulnerable while being manufactured or assembled and can be destroyed more economically at their source or in transit than on the field of action. Theater air forces participate in the destruction or neutralization of industrial targets within effective range of their aircraft, while concurrently carrying out operations against personnel and equipment en route to and from the battlefield. An effective interdiction program must be coordinated theater-wide to assure maximum coverage against those targets having the most significant effect on the theater mission. Although there is no firm line marking the area of theater air interdiction responsibilities, it is generally defined as that area extending from the narrow band marking the front line combat zone in which close air support missions are mounted to the depth of the theater area of responsibility.

Close Air Support

Close air support operations are indicated when the organic weapons of the surface forces are inadequate to achieve a desired objective. Targets are usually enemy personnel, materiel, or installations in the immediate battle area, where integration with the firepower of surface forces is required. Air attack behind a predetermined bomb safety line must be under the visual or electronic control of the Air Control Team, Air Coordinator, or Target Director Post.

The bomb line is an imaginary line arranged, if possible, to follow well-defined geographical features. Forward of the bomb line, air forces are free to attack targets within the over-all joint air-ground plan without danger to or reference to the ground forces. Behind the bomb line, all air attacks must be coordinated with the appropriate ground force commander and directed by one of the methods referred to previously.

TYPES OF MISSIONS

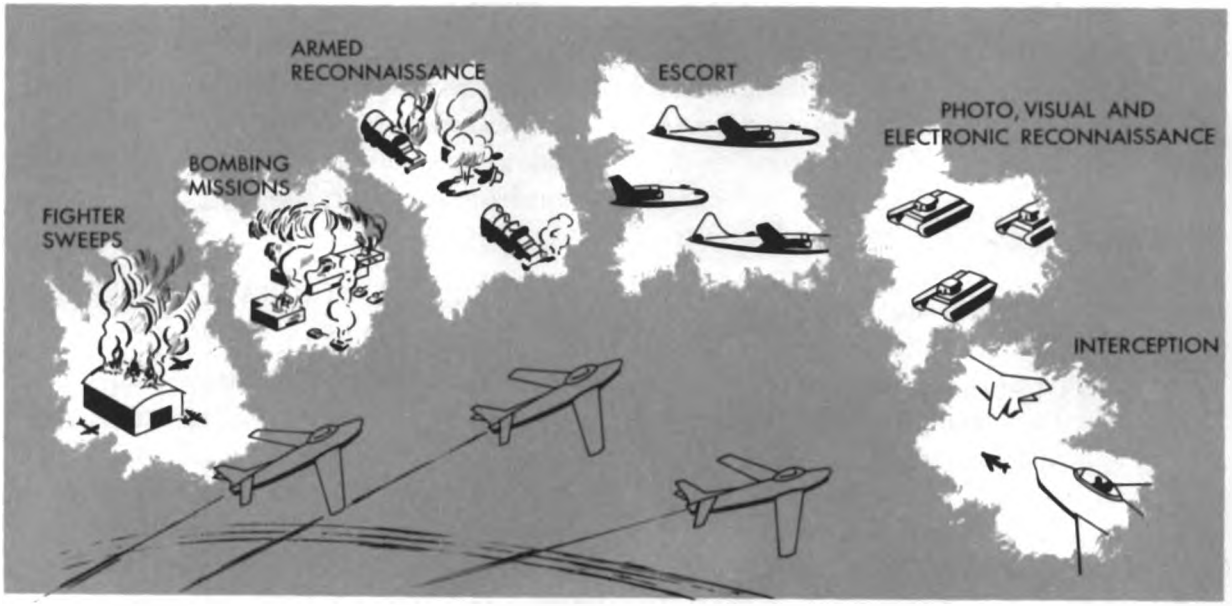
Types of fighter and fighter-bomber missions vary widely; according to the situation, fighters and fighter-bombers may be required to engage in any or all of the tactical air missions. Consequently, the tactical air pilot must be a jack-of-all-trades, thoroughly proficient in day or night operations under all types of weather conditions. He must be capable of air-to-air combat, bombing, and rocketry, and be able to strafe selected ground targets with lethal accuracy. His mission assignment may require him to fly escort, fighter sweeps, interception, combat air patrol, or armed reconnaissance, or to attack predetermined targets. He may be required to furnish close air support or column cover to surface forces, or engage in a wide variety of special missions.

Escort

Escort by tactical fighters provides security from enemy air attack for tactical or strategic bomber forces and for airborne or air transport formations. In addition, fighter-bombers carrying heavy external armament may require fighter cover to key targets. Because of speeds involved, high fuel consumption, and other characteristics peculiar to jet aircraft operations, escort, in most instances, will take the form of a fighter cover providing area support or, in a broader sense, a fighter sweep as described below.

Fighter Sweep

Fighter sweeps are counterair missions designed to seek out and destroy enemy air-



Types of Missions

craft in the air or on the ground. The latter course generally presents more lucrative targets, in both numbers and ease of kill. Fighter sweeps may be conducted completely independent of other air operations or performed in conjunction with bomber strikes, airborne operations, or other forces vulnerable to enemy fighters. Friendly fighters sweep the target area prior to arrival of the strike force to destroy or neutralize enemy aircraft before they materialize into a serious threat.

Interception

Interception of enemy aircraft before they may become effective against friendly air or surface forces or installations is one of the chief functions of tactical fighter aircraft. Success in this mission depends on skilled teamwork between the pilots and personnel of the tactical air control system.

Combat Air Patrol

Combat air patrol (CAP) is a planned mission designed to secure friendly forces and installations from enemy air attack. Aircraft patrol specified routes or orbit designated areas or points. Because it is basically uneconomical, CAP should be used only when a satisfactory early warning system does not exist or when an enemy air attack is imminent.

Armed Reconnaissance

Armed reconnaissance is a planned mission designed to search out and attack all suitable targets of opportunity along a designed route or within a prescribed area. Aircraft on armed reconnaissance carry any combination of armament deemed necessary. Visual observations made on armed reconnaissance missions are vital to air and ground commanders in future planning.

Attacks on Predetermined Targets

Predetermined targets are selected on the basis of information gathered from many sources, such as reconnaissance missions, ground observer reports, friendly agents re-

porting from behind enemy lines, and so forth. Planned attacks against these specific targets allow adequate time for detailed briefing and preparation, which results in more effective operations.

Close Air Support

Close air support missions, previously described, are known as either preplanned or immediate. Preplanned requests are normally submitted by the ground forces far enough in advance to be included in the daily operations order, thus permitting air units to plan and brief thoroughly on the details of the strike. Immediate requests result from unforeseeable enemy action over and above the destructive capabilities of ground forces. For such missions, aircraft are dispatched to the target area from air or ground alert status or possibly diverted from other missions already airborne against targets where timeliness is not a vital factor. Flights are normally briefed en route or in the target area.

Column Cover

Column cover amounts to a combination of close air support, armed reconnaissance, and combat air patrol designed to provide security to friendly columns from enemy air and ground attacks. A flight or flights orbit the column, reconnoitering to the front, rear, and flanks, and attacking any enemy air or surface elements which impede or threaten the progress or security of the column. An Air Control Team is usually located in one of the forward vehicles of the column to direct the orbiting fighters to appropriate targets.

Special Missions

Special missions include a wide variety of activity, such as cover or close air support for amphibious landings and airborne operations. Frequently, fighter-bombers are called upon to participate in air-sea rescue, psychological warfare leaflet drops, and other missions not directly connected with the immediate tactical situation.

TYPES OF AIRCRAFT ALERT

The requirements of air defense and close air support are ever-changing and, consequently, difficult to predict. Therefore, in these two areas of operation, it is often necessary to maintain aircraft on an alert status. The type of alert — air alert or ground alert — and the condition of operational readiness employed depend on the tactical situation.

In air alert, fighters are airborne over designated areas so that targets, either air or ground, may be attacked with a minimum of delay. Because of its high cost and low efficiency, this type of alert should be avoided whenever possible. There is no assurance that appropriate targets will appear during air alerts, and pilots may have to expend their munitions on lesser targets, thus reducing the over-all effectiveness considerably. Therefore, air alert aircraft are provided only when time and urgency dictate this type of alert. Air alert is most effective during a breakthrough, a counterattack, an anticipated enemy air threat, or an airborne or amphibious operation.

Ground alert signifies that the aircraft are fueled and armed and pilots are standing by for take-off within a specified time limit. Ground alert is employed when it is possible to anticipate the general type and degree of air effort required, but the combat situation makes it impossible to determine in advance the desired time of attack.

planning and executing the mission

PLANNING THE MISSION

Planning the missions of counterair, interdiction, and close air support requires consideration of the problem on a theater-wide basis by the theater air commander. He must make certain that the total efforts of the individual tactical air commands, or tactical air forces, are integrated into a single, powerful force capable of striking at a particular target in mass or of attacking widely separated targets simultaneously, according to the existing requirements. To accomplish this, the air commander prepares broad plans and policies and issues them to subordinate commanders for detailed planning and execution.

Counterair plans must take into consideration the fact that air forces and facilities may be replaced in a relatively short time. The enemy may replace his losses by moving in reserves, by increased production, or by bringing in forces from other areas. Therefore, appraisal of the enemy air threat must be continuous. The first consideration is the identification of those portions of the enemy air forces which pose the greatest threat to the theater mission. The enemy's air structure consists of air vehicles, air bases, operating personnel, and his industrial capacity. Depending on the circumstances, any of these might be the most profitable to attack.

Interdiction plans are directed to restricting or eliminating the flow of the enemy's sustaining resources. If maximum results are to be achieved, there must be a close coordination between the air and surface forces. The air forces will restrict the flow of enemy supplies to the maximum of their capability, while the surface forces must concurrently accelerate their surface action to cause a rapid attrition of the enemy's reserves and supplies. When the enemy is sufficiently weakened by this process, a situation favorable to maximum exploitation is created. Suitable targets in this program include enemy troop and supply concentrations; transportation facilities; ports; petroleum, oil and lubricants (POL); and other integrated systems necessary to the enemy's continued military effort. It is more economical and effective to destroy a single vital link in a system of crucial importance to the enemy effort than to destroy a great number of indecisive and unrelated targets.

Close air support consists of attacks by aircraft on hostile surface targets which are located in the immediate area of engagement between two opposing surface forces. This operation requires an organization skilled in the execution of its prescribed tasks. Detailed and continuous coordination between the theater air, sea, and ground forces engaged is mandatory for success. Furthermore, close air support plans must be integrated into the over-all theater operations, particularly prior to achieving air superiority, for this is precisely the time when the multitudinous demands on the available theater air resources will most certainly exceed the theater air force capabilities.

In the conduct of close air support operations, corresponding air and surface forces operate as an integrated team, although each will be under the command control of its own commanders. Close personal relationships are so essential to success in this type of operation that parallel levels of command cooperate and coordinate in planning operations of mutual interest, with each service supporting the activities of the others. Command decisions are normally limited to the tactical air command-army group and to the tactical air force-field army level, provided such groupings exist within the theater. When there is a difference in opinion between the respective commanders, the matter is referred to the next higher echelon of parallel air and surface commands for resolution. For those matters that cannot be mutually resolved on the parallel command levels, the theater commander is the final authority.

The major planning for close air support is performed at the tactical air force and field army level. However, it should be pointed out that the operations of the individual tactical air forces and field armies must be integrated into the over-all theater plan of maneuver.

Successful air-ground operations depend on a mutual understanding of each service's capabilities and limitations; therefore, a close personal relationship must exist between the air and surface force commanders and their staffs. To facilitate this understanding and to expedite the air-surface operations, the air force and surface force headquarters are located as close as possible to each other.

In determining the coordinated action required for day-to-day operations, it is necessary for each service commander to present his individual service plan of action for the following day at a daily planning conference. At this time, the surface commander makes known his requirement for close air support, as nearly as they can be anticipated. In most

instances, a portion of the air commander's forces will be directed against counterair and interdiction targets; if the remaining air effort is not sufficient to meet the total surface force needs for close air support, a target priority system must be established to employ the forces available as effectively as possible.

Although approval of air attacks in close air support remains with the air commander, he fulfills appropriate surface force requests as completely as possible with the forces he has available, consistent with sound aircraft and weapon utilization.

When the daily planning conference is ended and the tactical air force commander has made his decision as to his force employment for the following day, his operations staff, in conjunction with other staff members, prepares a formal directive outlining the decisions made and assigning specific tasks to subordinate air commanders. This directive is known as the daily operations order.

The operations order informs the fighter and the fighter-bomber unit commanders of the specific tasks each particular unit will be required to perform, as well as the mission of the command as a whole. The operations order also indicates the administrative and logistical support required and the command and signal details affecting the operations. An example of the operations order is shown on the following page.

Frequently, the logistics, command, and signal details remain static over a period of time and it is not necessary to include this information in the daily orders. Consequently, fragmentary orders (frag orders) are often issued in lieu of complete operations orders, or as a later modification of the original order.

The fragmentary order, or the operations order, as the case may be, alerts the unit commander, who, together with his operations officer, thoroughly reads and understands its contents and intent. Thereafter the individual squadrons must be informed immediately, in writing or orally, of their proportionate share of the total commitments, armament required, and other pertinent information. The intelligence section and the ground liaison officer must become thoroughly familiar with the contents of the operations order so that they may prepare their portion of the pilot's briefing. The weather officer must know the general routes, destination, and the times involved in order that he may prepare his weather forecast. Numerous supporting facilities and organizations on the base, such as the mess officer, the AACS personnel (who are the tower and navigational aid operators), crash and refueling crews, and the armament and maintenance crews, must be informed of take-off times. It is the responsibility of the operations officer to see that no detail is overlooked.

Successful operations depend on the entire wing organization working as a team with but one purpose in mind. The purpose, of course, is to make certain of the destruction of the selected target at exactly the right time and place. All of the years of planning and training, and the great financial and personal costs and sacrifice, will be vindicated by the successful execution of the mission; likewise, all will be wasted by failure, regardless of its cause.

The operations officer is responsible for the over-all planning of the mission and for presenting appropriate details to all concerned at the pilots' briefing. Each mission should be planned and briefed as if it were the most difficult yet assigned.

Annex 'A' to STANAG No. 2014 (Draft)

SECURITY CLASSIFICATION
(Changes from verbal orders, if any)

COPY NO.

Issuing Headquarters

Place of Issue
(May be in code)

Date/Time Group of
Signature

Message Reference
Number

TYPE AND SERIAL NUMBER OF OPERATION ORDER

References: Maps, charts, and relevant documents

Time zone used throughout the order: (If not necessary, omit)

Task Organization:

This information may be given either here or in Paragraph 3. Under this heading as appropriate give the subdivision of the force, including attached units, together with the names and ranks of the commanders.

1. SITUATION

Give briefly the general picture, so that subordinate commanders will understand the current situation, under the following headings:

a. Enemy Forces
Composition, disposition, location, movements, estimated strengths, identification and capabilities.

b. Friendly Forces
Information of friendly forces other than those covered by the operation order which may directly affect the action of subordinate commander.

c. Attachments and Detachments.
When not given under Task Organization, list here units attached to or detached from the issuing unit (or formation) by this order together with the times they are effective.

2. MISSION

A clear, concise, statement of the task of the commander and its purpose.

3. EXECUTION

In the first sub-paragraph give a summary of the overall course of action intended. In subsequent sub-paragraphs assign specific tasks to each element of the command charged with the execution of tactical duties, give details of coordination and the task organization/grouping, if not already included under the heading "Task Organization." If desired, instructions applicable to two or more elements of the command may be placed in a final sub-paragraph headed "Coordinating Instructions."

4. ADMINISTRATION AND LOGISTICS

Contains a statement of the administrative and logistical arrangements applicable to the operation. If lengthy, or not ready for inclusion in the operation order, may be issued separately and referenced here.

5. COMMAND AND SIGNAL

Contains signal, recognition and identification instructions, electronic policy, headquarters locations and movements, code words, code names, and liaison.

Acknowledgement Instructions

Signature of Commander

Annexes:

Distribution:

Authentication:

SECURITY CLASSIFICATION
NATO — RESTRICTED

Operations Order

Following receipt of instructions from the group, the squadron operations officer becomes a key member of the planning team. He must select his crews, and inform the squadron engineering, armament, and communications officers of the total aircraft commitments, armanent requirements, and radio frequencies necessary for control of the mission. It is mandatory that all of these sections maintain close liaison throughout the entire period covered by the operations or frag order. The engineering section must immediately inform all concerned of the status of an aircraft as soon as it returns from a mission, so that the proper planning may be initiated or completed for subsequent missions. All aircraft must be refueled and rearmed immediately upon landing so that they will be ready to cope with any emergency that may develop. As the close of the mission period approaches, the tactical air force headquarters normally dispatches a warning order anticipating the following day's requirements, so that the necessary preliminary planning may be accomplished in the tactical fighter and fighter-bomber units.

Mission planning is an individual responsibility of each man in the organization, down to the least experienced pilot. Whether the task involves a group, squadron, flight, or element, each leader must be absolutely certain that all members involved in the operations are briefed with crystal clarity and know precisely what part each is to play and what functions each is to discharge with respect to that particular mission. The leader must brief his men thoroughly on the tactics to be employed in any given instance, on emergency procedures, on in-flight signals, and on other pertinent matters to the point where any man on the mission is capable of taking over the lead if need be.

EXECUTING THE MISSION

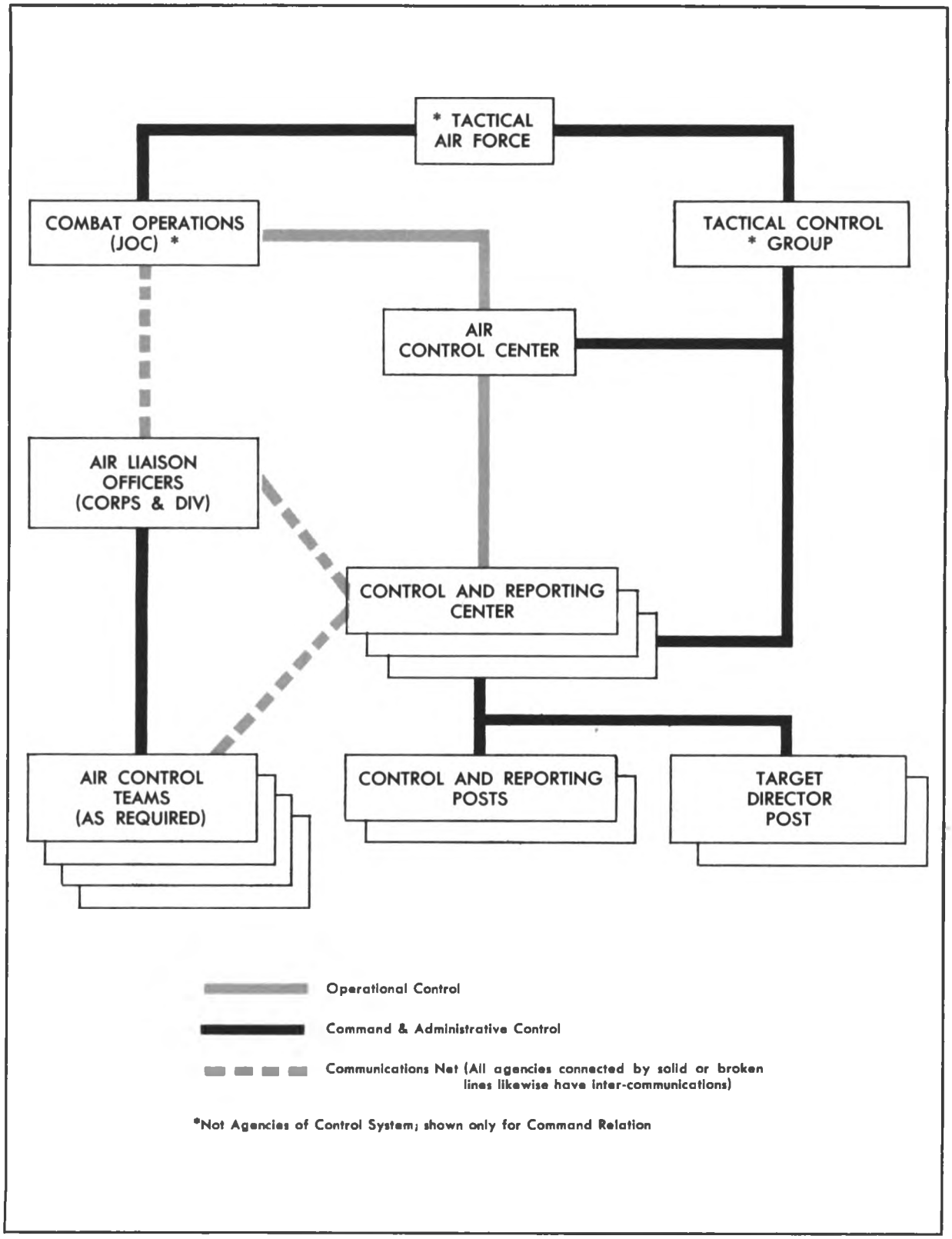
Executing the mission is merely the "payoff" of the prior planning, preparation, and briefing. Air planning begins at the highest air level in the theater and extends down through the tactical air force organization to the least experienced pilot.

To a certain extent, planning continues through the actual mission. Generally, however, the premission briefing represents the climax of the planning and the beginning of the actual mission. Therefore, an accurate and comprehensive briefing is a very vital part of successful tactical air operations. Fundamentals of good briefing techniques and procedures are presented in Chapter 3.

Regardless of type, and whether it be counter-air, interdiction, or close air support, the mission involves certain procedures that must be followed if the tactical air commander is to maintain the necessary degree of command and control over his air forces. In effect, the entire tactical air force is a control system specifically designed for obtaining maximum utilization of the characteristics inherent in tactical aircraft. Two vital questions, the answers to which the air commander must know instantly, and at all times, are: (*A*) *WHERE AND HOW ARE THE THEATER AIR FORCES DEPLOYED?* (*B*) *HOW MAY THEY BEST BE CONCENTRATED, DISPERSED, OR DIVERTED?*

The air commander must know these answers because he is responsible for shifting his air force rapidly from one area to another to meet any and all emergencies which may develop within the theater at any time.

Command and control of the air capability are exercised through the tactical air control system. The illustration on the next page shows the organization of the tactical control system; the illustration on page 17 shows its deployment in the field.



Organization of Tactical Control System

Mission Control

Although the tactical air control system provides the communications facilities necessary to direct the air effort, it is the air combat operations officer in the Joint Operations Center at the tactical air force, who, acting for the air commander, operationally directs the execution of the daily air plan. It is his responsibility to ascertain that the specific task depicted in the operations order is carried out promptly and successfully by the tactical units concerned. Additionally, final decision on requests for immediate air effort, originating from either air or ground force sources, which are all channeled into the JOC, rests with the combat operations officer. Those requests initiated by surface forces are first perused by Army or Navy representatives, as appropriate, attached to the JOC. These representatives furnish the combat operations officer with a continuing up-to-the-minute status of the surface situation and provide a ready means of effecting the coordination necessary for integrated air-ground operations. The appropriate representative will either recommend approval and pass the request on to the combat operations officer or return it to the originator with reasons for disapproval. If the request is ultimately approved, a tactical unit will be notified to scramble the required effort from aircraft on standby status, or the Air Control Center (ACC) may be directed to divert aircraft already airborne.

The Air Control Center is located adjacent to the JOC and is the principal control facility of the tactical air control system. It is within this center that the current over-all air situation is displayed for the ready surveillance of the air commander. From this picture he, or his authorized representative, can quickly analyze the effectiveness of the air plan and shift his forces, if necessary, to meet a changing situation. The Air Control Center supervises and provides over-all direction to the entire air control and warning activities of the tactical air force.

As soon as practical after becoming airborne, the tactical leader of a flight, squadron, or group, whatever the mission strength may be, reports in to the Air Control Center, giving appropriate data to identify his mission. The controller checks with the air combat operations officer in the JOC to determine if the formation is to continue as originally briefed or is to be diverted to a target of higher precedence requiring immediate action. If the latter is the case or if the formation was scrambled from a ground alert status without opportunity for detailed briefing, the ACC controller provides the tactical leader with the minimum details necessary to accomplish the mission objective. In any event the formation is then normally directed to a Control and Reporting Center (CRC) for more specific control and direction. Under certain circumstances, such as excessive distances involved or for any other reason that may make it undesirable for a flight to report directly to the Air Control Center, procedures are often established whereby the leader may report initially to a CRC. The CRC then queries the Air Control Center, through established communications channels, for the required information.

The Control and Reporting Center, of which there is one or more within a tactical air control system, is located as far forward as security will permit. It contains the radar elements of the tactical air control system. Branching out from the Control and Reporting Center are highly mobile, lightweight radar stations, called Control and Reporting Posts (CRP), and Target Director Posts

(TDP). The Control and Reporting Center, along with its supporting elements, plays a vital role in all tactical air operations. A continuous plot is maintained on all radar sightings in the area, and, when unidentified sightings appear, friendly fighters or fighter-bombers are vectored into position for air attack or ground alert aircraft are scrambled, through the JOC, for intercept. Whether the fighters or fighter-bombers are prebriefed, scrambled, or diverted from original missions as they check in with the Control and Reporting Center, the controller will give them further instructions pertinent to the type of mission involved. If the fighters are on a prebriefed fighter sweep, he will inform them of all enemy air activity in the area and vector them if possible. Likewise, he must keep those aircraft on interdiction missions posted on the latest air situation. If the mission involves close air support operations, he will normally direct the aircraft to a more mobile forward control element, such as an Air Control Team (ACT), an Air Coordinator, or a Target Director Post (TDP), for further direction.

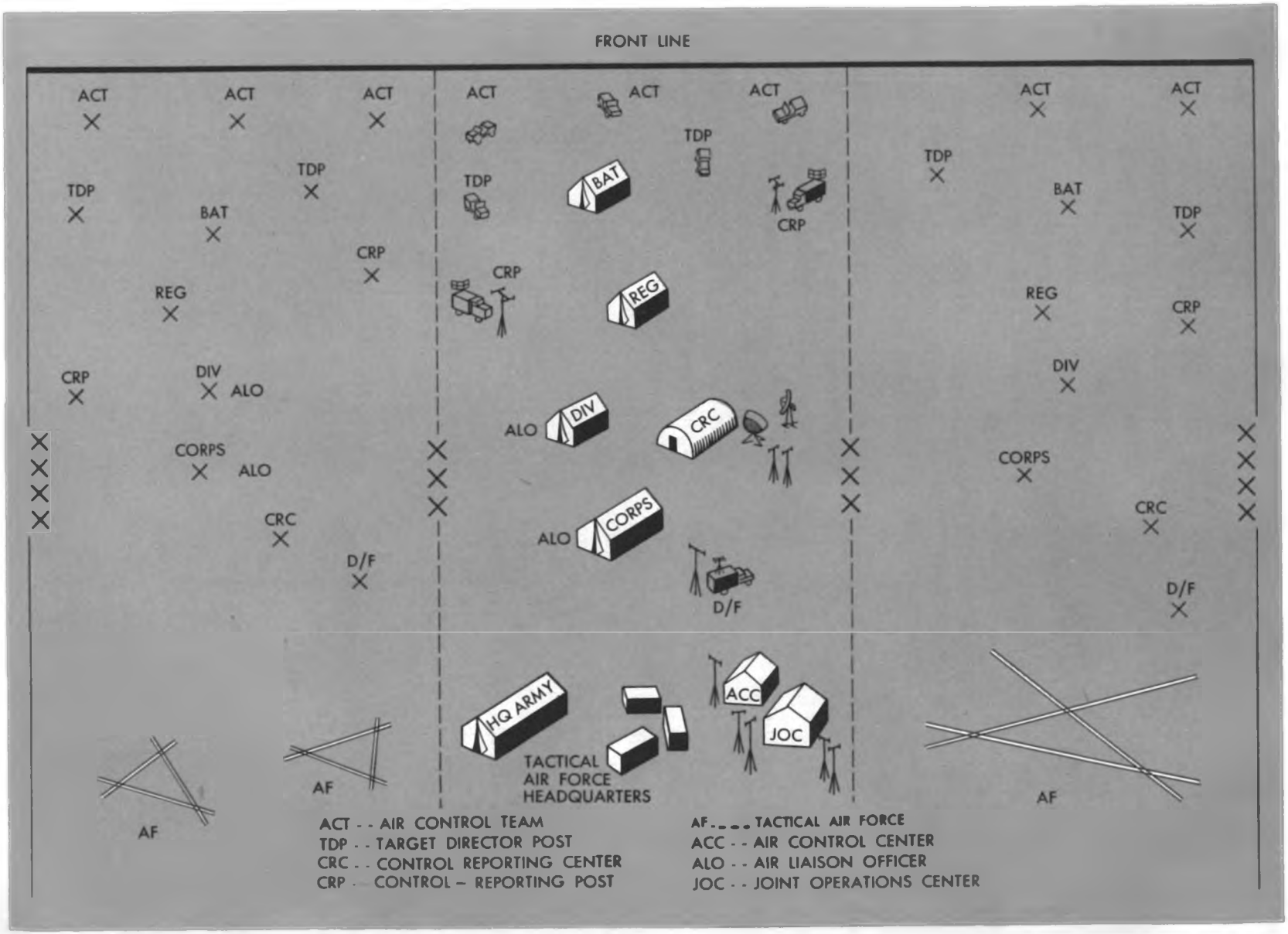
Target Director Posts (TDPs) are radar and radio facilities capable of directing or positioning aircraft over pinpoint targets or to precise positions over geographical coordinates during night or bad weather or during other operations requiring electronic control.

Air Control Teams (ACTs) are located with forward infantry, armored, or airborne units. Strikes are directed visually by the Forward Air Controller (FAC) of the team. The Forward Air Controller is a combat-experienced fighter or fighter-bomber pilot, selected for his experience in close air support matters and placed on temporary duty for a specified period of time with the Air Control Team.

Although the primary function of the Forward Air Controller is the visual direction of aircraft attacking within the bomb safety line, he has a number of associated and vitally important duties. He must consider that he is the personal representative of the tactical air force commander to the particular unit to which he is assigned and is responsible for all that such a position implies. He advises the immediate ground commander and his staff on matters pertaining to tactical air operations. Conscientious performance of this duty is vital to the improvement of air-ground relationships and mutual understanding. He receives and disseminates information received from aircraft which is of interest to the immediate ground commanders. He reports the observed results of air strikes as required. All fighter and fighter-bomber pilots must be thoroughly familiar with and prepared to perform the duties of forward air controlling.

The Air Coordinator is an experienced forward air controller who performs his function from an airplane. The tactical situation dictates the type of aircraft provided; it may vary from light aircraft to high-performance fighters. Generally, an Air Coordinator performs his functions in conjunction with ground elements of the tactical air control system. In cases where the battle or strike area is isolated from other elements of the tactical air control system, such as during airborne operations, full authority may be vested in the Air Coordinator to direct as well as to control strikes.

The final decision whether to attack a specific target must rest with the formation leader. This decision is exercised after the leader has reported into the mobile control element and has been given visual or electronic directions to the target. Obviously, this responsibility is a heavy one and only



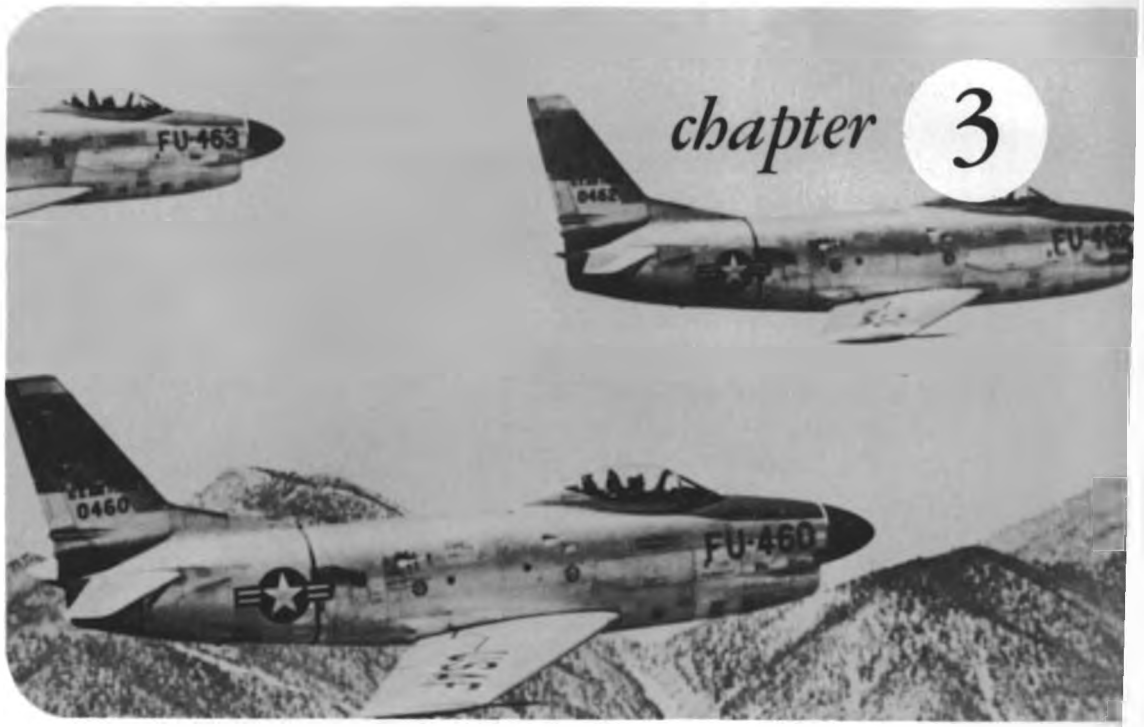
Deployment of the Tactical Air Control System

leader has reported into the mobile control element and has been given visual or electronic directions to the target. Obviously, this responsibility is a heavy one and only experienced pilots should be placed in the position of making this final decision. Upon arrival over the target, the formation leader becomes the air commander with respect to the particular target under consideration, and must exercise the air commander's decision and decide (a) that the particular target is suitable for attack by the munitions the formation is carrying, (b) that the target is positively identified, (c) that friendly personnel will not be jeopardized by the attacking formation, and (d) that the contemplated attack will not expose the personnel and materiel of the formation to needless and prohibitive losses.

Checking out with the final control agency is accomplished by the formation leader, who reports the results of his strike as observed by him. Additionally, from his observation vantage, the leader will relay to his control source such other information as may be of vital interest or of value to the final controller or the surface forces with whom the formation has been working. From a combat morale standpoint, this is one of the highlights of the mission. Both the formation leader and the members of his flight, no less than the final controller and the surface forces, are concerned with the strike results and want to know immediately what each has done to help the other. There can be no fixed approach to this aspect of the operation other than to reiterate its importance to the air-ground effort and harmony.

Returning from the mission, the formation leader will also check out with such other agencies as his formation has worked with, particularly with the Control and Reporting Center (CRC) and the Air Control Center (ACC), giving spot reports on results achieved and other vital information. The formation leader must take particular pains to report, as accurately and completely as possible, on any remaining targets of a fleeting or mobile nature that require immediate attention.

Upon landing, all pilots will be debriefed immediately by appropriate operations, intelligence, weather, and ground liaison personnel. Each pilot, on every mission, should make written or mental notes of his observations during his flight. What may seem insignificant to the individual pilot may be of vital interest to commanders who are constantly trying to piece together, from every possible source of information, assumptions and estimates of the enemy's plan of action. A pilot who systematically notes, remembers, and in his debriefing tells accurately and completely what he has observed on his mission will make an invaluable contribution to the achievement of the tactical air force objectives. In addition, he will make a tremendous contribution to the surface forces and will provide information which will aid those commanders in formulating plans for the future employment of their own personnel.



chapter 3

tactics and techniques

BASIC TACTICS

Air Superiority

Offensive doctrine involves both offensive and defensive combat, for both actions are waged either at the same time or successively in the over-all offensive action. True offensive doctrine consists of creating favorable situations when they do not otherwise exist, striking at the enemy with the maximum power at the decisive time and place, and driving home the effort determinedly until the desired results have been accomplished.

The end goal of counter-air operations is to achieve air superiority on a theater-wide scale; however, it is sometimes necessary to establish air superiority temporarily within a predetermined area. To accomplish this, the tactical air effort must be directed and concentrated in mass to deny the enemy access to the areas under consideration. Supporting agencies of enemy air, including airfields; supply depots; petroleum, oil and lubricants (POL); and communications must also be destroyed or neutralized.

These counterair tasks are of prime importance and of continuing nature, since air superiority provides freedom of action and movement for friendly air and ground units while denying these freedoms to the enemy.

In the early phases, security of friendly operating areas must be obtained while efforts are made to penetrate the enemy air defenses and destroy or neutralize his air capabilities. Local air superiority is mandatory, but will be difficult to maintain while the enemy is able to mass his aircraft and challenge the friendly effort. Fighters covering bombers during this period will be exposed constantly to aerial combat. They may also be engaged in typical offensive action, such as airfield strikes and flak suppression missions. During this period, the enemy will be active in similar attempts to destroy friendly installations.

The destruction or neutralization of the enemy offensive air arm is necessary in the fight for air superiority.

Escort

Escort problems have been magnified by the current speed capabilities of bombers and the rapid fuel consumption characteristics of jet fighters. Although certain fundamentals apply to escort tactics in general, tactical procedures will vary considerably according to the local situation, types of aircraft involved, and other facts. Furthermore, escort tactics can be expected to change with the ever-changing capabilities of aircraft and equipment. The success of basic tactics in the case of opposing fighters having nearly equal speed and altitude ranges lies in the ability of the escort aircraft to detect the attacking aircraft in sufficient time to position themselves for defense of the bombers.

Air Superiority Is Mandatory

This defense is accomplished by use of speed, altitude, and/or maneuverability to break up or compromise the enemy attack.

The extremely high speed of today's fighter and the resultant rapid rate of closure by attacking aircraft — aided, more than likely, by radar control — may give the attacking aircraft a distinct advantage. The enemy may be able to surprise a formation and press through his attack before the escorting fighters are able to become effective. To offset this possible enemy advantage, airborne detection devices may be used to spot the attacking force before it comes into sight, thereby enabling the escorting fighters to be prepared for attack. Other means of compromising the enemy advantage are diversionary tactics or deceptions and fighter sweeps preceding the bombers and directed against airdromes and enemy aircraft before they can assemble for attack.

The fundamentals of escort tactics may be summarized as follows:

The presence of friendly fighters above the bombers requires the enemy to descend through levels of friendly aircraft to attack if he is to exercise an altitude — and hence speed — advantage over the friendly force. If the enemy does not choose to do this, he is committed to a side attack at a closing speed which renders him more vulnerable to friendly fighter attacks or to counterfire by the bombers. From such an attack, the enemy cannot easily position himself for another attack.

Cruise control by the friendly fighters should be at minimum power consistent with the acceleration characteristics of the aircraft, with fuel consumption, with the type enemy aircraft and nature of attack which may be expected, and with the probabilities and nature of encountering hostile aircraft. Relief must be accomplished on station with sufficient fuel and ammunition remaining to enable the fighter to arrive home safely.

Squadrons and flights must be briefed specifically on their assignments during the escort period. The squadron commander or the group commander must delegate responsibilities prior to becoming airborne since the span of control of jet fighters is considerably reduced in the air. The escorting force may be split into two or more units with each unit assigned a definite area of responsibilities. All units retain altitude advantage over the bombers, the highest unit down sun of the bombers and the lowest unit up sun. The horizontal and lateral distances of the protective forces are determined by the possibility of encountering enemy aircraft and the enemy's possible numbers, aggressiveness, and deployment.

The primary mission of the escorting aircraft is protection of the bombers. This is accomplished by breaking up coordinated attacks by enemy fighters and then returning to the area of responsibility. Deserting the bombers to destroy enemy fighters which are not an immediate threat can be disastrous. If friendly fighters are diverted, the bomber stream is vulnerable to further enemy attacks.

Escort procedures for troop carrier or fighter-bomber operations are essentially the same as for bomber formations.

Fighter Sweeps

Fighter sweeps are flown to seek out and destroy enemy aircraft on the ground and in the air within the confines of a certain preselected area. Fighter sweeps may be used in conjunction with or as another form of escort to break up any grouping of enemy

aircraft designed to intercept the friendly bombers. Sweeps may also be employed to insure air superiority over a beachhead or in maintaining air superiority once it has been established within an area of operations.

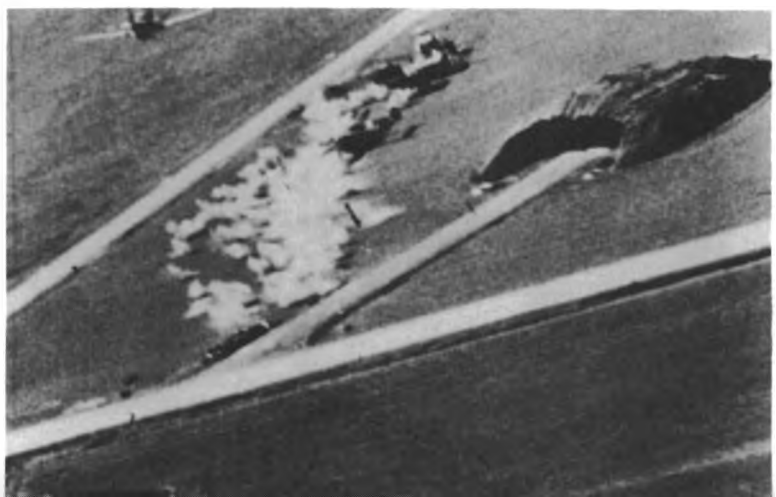
When a striking force is assigned to a particular sweep mission, areas of responsibility should be clearly indicated. Since the mission may involve air-to-air combat, specific information regarding disposition of forces and tactics should be covered thoroughly by the strike force commander. Generally, it is desirable to employ as many fighters as possible, so that numerical superiority can be achieved. Tactics outlined should include disposition of aircraft, position regarding sun, and offensive and defensive tactics.

Each fighter sweep should be planned and conducted as a maximum-range mission. Time in target area may well be the deciding factor regarding mission effectiveness. If the sweep requires deep penetration, munition and fuel minimums should be planned so as to allow ample safety factors en route to the home base, during which time the striking force is most vulnerable.

Interception

Interception of intruding aircraft grows more difficult with the increase in aircraft speeds. Intruding aircraft must, of course, be detected in time to permit interception prior to their attack. Furthermore, it is to the defender's advantage to detect the intruder as soon as possible so that the situation can be evaluated and intercepter aircraft properly deployed. Successful interception of the enemy depends on several factors; namely, the speed of the target, range and location of radar, time required for identification and scramble, location of air bases, the rate of climb and speed of interceptors, and the capability of AAA defense.

As previously stated, there are two types of aircraft alert — ground alert and air alert. The immediate tactical situation dictates the number of aircraft on alert, their alert and readiness status, and their disposition. Ground alert may be staged in varying periods of readiness from 12-hour standby to immediate scrambles. Immediate scrambles call for pilots to be sitting in their cockpits in order that they may become airborne as quickly as possible after receiving a scramble order. En route to the interception, the pilot receives all available target informat on from the controller. If time permits, the controller places the interceptor with an altitude advantage and a favorable position for an attack. Radio transmissions are normally coded as a precautionary measure and all orbit points, if established, are given code names. The GEOREF grid system is employed to enable the pilot to identify his position to the controller in areas where permanent radar echoes exist.



When air attack is imminent or strongly suspected, an airborne alert flight, or flights, may be employed. These flights are called combat air patrols (CAP). The CAP is placed with an altitude advantage over the intruder when possible. CAP's are relieved on station with sufficient fuel to make at least one interception. In areas where air attack is probable, it is generally the practice to maintain a CAP at dawn and dusk, since these are the hours during which attack by hostile aircraft is most probable.

Upon landing, alert aircraft must be rearmed and refueled, since it is important that all aircraft be combat-ready and immediately available for air defense. An aircraft being refueled is not an offensive weapon; it is merely a lucrative target.

Aircraft on interception missions may be either day fighters or all-weather fighters. Generally, the day fighter, unimpeded by radar gear, can outperform the all-weather fighter. The all-weather fighter, on the other hand, has the advantage of being able to penetrate adverse weather in an attempt to intercept intruders. Fighter-bomber aircraft are used in the day fighter roll when necessary. Once air superiority has been attained, a relatively small number of interceptor-type aircraft can handle interception commitments, allowing the fighter-bomber aircraft to devote more effort to interdiction and close support requirements.

Attack on Airdromes

Attack on airdromes requires considerable detailed preplanning. Heavy, medium, and light flak may be expected in all degrees of intensity. Flak emplacements are generally of permanent nature, well entrenched, and protected by sandbags or similar abutments. Since approaches to airdromes are relatively flat, light flak weapons can be used with maximum effectiveness. However, antiaircraft emplacements are difficult to fully camouflage, because they fire through a 180° overhead arc.

Aircraft may be in revetments, camouflaged, or dispersed in natural cover surrounding the field. Dispersion, camouflage, and defense are usually governed by the immediate tactical situation.

Prior to the attack, aerial reconnaissance should be made and the strike force commander provided with the most recent photographs of the target. The photographs should be interpreted and all pertinent information — such as antiaircraft emplacements, dispersion of aircraft, dummy aircraft, and hangar installations — noted thereon. The strike leader may then make specific target assignments, arrange the necessary coordination and timing of attacks, and prescribe the tactics to be employed. In some instances, it will be desirable to split the attacking forces to make coordinated attacks upon specific areas of responsibility. If it is necessary to employ

large numbers of aircraft, an attack in waves may be desirable.

When heavy enemy fire is expected, flak suppression or neutralization may be considered advisable. Use of area weapons, such as proximity-fused bombs or possibly napalm and smoke, enable attackers to approach with minimum exposure.

The attacking force should use every advantage of terrain and altitude to approach the target undetected, since the element of surprise will reduce friendly losses. The generally accepted attack technique on well-defended targets is to approach the target at a minimum altitude from a pre-selected landmark. A combat hump (a sudden ascent to fire altitude) may be executed for orientation and target selection when the outer perimeter is reached. A firing pass is then made, after which no attempt is made to regain altitude until well beyond range of the defender's guns. The amount and intensity of defensive fire and the target will determine the number and type of attacks made on the airdrome. A single pass is often the rule against well defended airdromes.

Thorough planning and preselection of targets are essential. Preselection should be carried to the extent of assignment of specific targets to individual pilots, if possible. In planning the attack, every effort should be made to provide for surprise and saturation of the enemy's defense. If these principles are adhered to, effectiveness will be increased with minimum friendly effort and losses.

Interdiction

Interdiction targets include railway and highway bridges, tunnels, rail lines and highways, marshalling yards, supply dumps, rolling stock, vehicles, and even troops. Destruction of the enemy's logistical and communications chain is the primary mission in this phase. Interdiction targets are attacked by aircraft on either preplanned air strikes or armed reconnaissance missions.

PREPLANNED AIR STRIKES. When sufficient target information is available, the attack may be planned in detail prior to take-off. Usually photographs and other identifying information will be furnished pilots participating on planned missions. This enables the strike leader to plan his mission and type of attack thoroughly, taking into consideration such factors as terrain cover, antiaircraft, and identifying land marks. If intense flak is expected, a portion of the attacking force may be employed for a coordinated attack on antiaircraft installations. Through the use of area photographs, the leader is able to assign specific targets and thus increase the effectiveness of the mission. The route to the target should be planned to avoid areas of intense flak and to arrive at the target area with some advantage of surprise. If hostile air activity is expected, top cover may be assigned to prevent a surprise attack from interfering with the mission. If the fighter-bombers are forced to jettison their munitions to fight off attackers, the enemy has successfully defended his target.

Secondary or alternate targets must be assigned so that the mission may be diverted effectively if the primary target is destroyed before munitions have been expended or weather conditions prevent a successful attack. The strike leader must exercise care in selecting secondary targets, since bridges or like installations that friendly forces may desire for eventual use must not be unwittingly destroyed.

Discretion and prestrike planning on the part of individual strike leaders can increase the effectiveness of the interdiction program.

Fuel and munitions permitting, return from the target should be planned to enable the striking force to seek out and destroy targets of opportunity. The attacking force may be split, with definite route assignments, so that maximum effectiveness is realized from the mission. If at all possible, actual results of the strike should be determined prior to leaving the target. Pilots should be particularly observant and report any definite or suspected enemy targets.

ARMED RECONNAISSANCE. Armed reconnaissance is accomplished by seeking targets of opportunity along a predetermined route or in a designated area. It is used primarily to deny the enemy use of roads and railway facilities and to detect, harry, or hinder any efforts on his part to build up troop and/or supply concentrations. In this phase of combat operations, the fighter-bomber pilot is both hunter and killer, and this is probably the most exacting of all tasks assigned to him. It calls for the greatest skill and initiative to be exercised by the individual flight commanders.

Armed reconnaissance is normally accomplished by small numbers of aircraft because of the constant maneuvering and flexibility required in this type of mission. In areas where enemy air is active, however, aircraft must be employed in numbers consistent with the amount of enemy air activity, with a portion of the striking force being used as top cover. In this case, one unit generally covers the route at a low altitude while the second unit positions itself in such a manner that it may readily observe and take positive action for defense against enemy aircraft or gun positions. The amount and intensity of enemy fire will determine the reconnaissance altitude and tactics.

Generally, flights should be conducted at reduced throttle settings over the route because targets must be detected visually. However, this technique must never be carried to the extreme lest it jeopardize the chances of survival if the flight is attacked by enemy aircraft. If the route selected passes enemy strong points or heavily defended areas, evasive action should be taken to reduce the possibility of damage from ground fire.

If intense enemy fire is encountered, lucrative targets are usually in the immediate area; it can be assumed that the enemy is defending something of value. When this condition is encountered, pilots should exercise vigilance in attempting to discover these targets. Techniques of enemy camouflage will vary in proportion to his cleverness and immediate tactical needs. Pilots must assume that the enemy is present in the assigned area and, through the medium of camouflage, is concealing his equipment from friendly aircraft. The absence of vehicles and trains along specified routes does not necessarily mean those routes are not being used, but may indicate that the enemy has been successful in concealing the movement. There are many methods available to the enemy to accomplish this.

If the flight encounters an area of suspected enemy activity, the hunting element should investigate the area at a very low altitude and try to detect the target from an oblique view. It is the tendency of many pilots while on reconnaissance to look only on the roads or the railroad tracks. Targets on roads and railroad tracks are easily detected. The pilot should devote most of his attention to looking off the road, being particularly alert for evidence that will disclose enemy activity.

Armament used on armed reconnaissance missions may consist of rockets, machine guns, napalm, or general purpose bombs. Ar-

mament selection against specific targets should be considered carefully. Against any type of target, munitions should be expended as frugally as possible so that reconnaissance may be continued. It is an all-too-common tendency among flight leaders to expend their entire munitions load against one target, although better targets may subsequently be found. Flight commanders must exercise excellent judgment throughout the mission, weighing such factors as fuel, time left in the area, and type of target attacked, so that the mission can be conducted with maximum effectiveness. Preflight planning for the mission should include selection of a good secondary target in case the reconnaissance proves fruitless.

Since part of the mission of armed reconnaissance consists of gathering intelligence for higher echelons, flight commanders should make every effort to report accurately incidents of an unusual nature that are encountered along the route. If an unusually large enemy movement is detected, flight commanders should immediately furnish controllers with this information. When reporting results of reconnaissance, it is extremely important not only to report the exact position of the targets but also the direction in which they are moving and their speed and number so that target information may be evaluated properly by intelligence. Accurate target reporting is imperative, for in this manner enemy buildups may be detected.

Whenever possible, it is desirable to continue assignment of flights to the same areas of responsibility for armed reconnaissance because a pilot covering the same general route daily is quick to recognize any change within his area, such as fresh tracks leading off the roads and abnormal activity in villages. In addition, the pilot is relieved of the burden of low-level navigation over unfamiliar terrain and can devote himself to his task of detecting enemy movement.

The answer to the question, "What would you do with your equipment if you were the enemy?" might well spell success of armed reconnaissance missions. If a large amount of enemy activity is encountered, it is recommended that the pilot use symbols so that he can plot target information more effectively.

Close Air Support

Close air support of surface forces in contact with the enemy requires close coordination with the fire and movement of the friendly forces. It is highly desirable that close air support missions be of a planned nature to allow target evaluation and briefing. However, because of the transitory nature of many close air support targets, or unforeseen tactical emergencies, fighter-bomber aircraft may be placed under conditions of air or ground alert, or diverted, after airborne, from other missions having a less vital time factor.

Control of attacks behind the bomb line is normally accomplished by a Forward Air Controller (FAC), trained in the techniques of visual direction of fighter-bombers in close support activities. He is equipped with vehicular-mounted and portable command radios. The FAC, together with radio operators and equipment, forms an Air Control Team (ACT). Targets may be identified by verbal direction, reference to grid coordinates, marking with colored smoke, employment of panels, or by the use of pyrotechnics. Targets within the bomb line require positive control by the Air Control Team (ACT), Target Director Post (TDP), or Air Coordinator.

Remember that the bomb line is an imaginary line forward of which air forces are free to attack targets within the over-all joint air-ground plan without danger to or reference to the ground forces. Behind the bomb line, all air attacks must be coordinated with the appropriate ground force commander.

After contact with the Forward Air Controller has been established, and the target adequately identified, the flight leader sets up the attack on the target. Generally, all firing is done toward enemy lines to prevent friendly casualties. On the first pass, the strike leader should fire a short burst from his guns to mark the target, after which the target should be confirmed by the Forward Air Controller before fire is continued. This is especially necessary when firing into hidden enemy troop entrenchments or similar installations. If enemy antiaircraft is anticipated or encountered, the attack pattern is varied to reduce the possibilities of being tracked by enemy guns. If intense ground fire is encountered, the break-off from the target should be made in such a manner as to minimize the effectiveness of enemy fire. (See Flak Evasion.) It may often be desirable to have friendly ground forces provide flak suppression fire prior to, and even concurrent with, the air strike, with the only limitation that no VT fused rounds be employed within a prescribed radius of the target. The highly remote chance of being hit by friendly artillery does not outweigh the advantages of reduced enemy fire effectiveness.

If enemy air activity is probable, the attacking force may be divided, with one element working on the target and the other element flying top cover. After the first element has completed its attack, the roles are reversed. If an enemy air attack is improbable, and it is desirable to have the entire striking force firing at the target, a coordinated attack should be devised to provide mutual support against possible enemy ground fire. Enough ammunition *should always* be retained to enable the striking force to defend itself in the event of hostile air attack.

Secondary targets will be provided in front line areas so that the flight can still achieve maximum effectiveness if the primary target is destroyed before munitions beyond a safe reserve have been expended and fuel considerations prohibit a new target area assignment.

Controlled air strikes are also conducted by means of electronic control by the Target Director Post (TDP). In such strikes, tactics may be dictated by the capabilities of the electronic equipment.

Column Cover

Column cover operation, under certain conditions, may be necessary to protect a tank column or a convoy from air or ground attack. This type of air action combines the roles of combat air patrol, armed reconnaissance, and close air support. A flight or flights of aircraft fly top cover to defend against enemy air and perform armed reconnaissance to seek out and pin down potential enemy ground opposition, while road blocks and enemy defenses are neutralized by controlled air strikes utilizing a Forward Air Controller located with the column. Tactics and techniques are similar to those outlined in previous pages, and here, as in other cases, the fighter or fighter-bomber may exercise its versatility in performing many tasks on one mission.

Support of Amphibious Operations

Invasions and amphibious attacks are characterized by comparatively small land areas needing continuous air cover until sufficient

Typical Fighter and Fighter Bomber Missions

penetration of enemy defenses is accomplished. Preceding an invasion, complete air superiority must be assured, and isolation of the battlefield, through a carefully planned interdiction program, is of the utmost importance to the success of surface forces. Tactics do not vary greatly from those described for the different phases of fighter activity described for column cover. During the initial stages of an amphibious operation, control of air effort is normally accomplished from an Air Control Center established on a ship known as the Amphibious Group Command (AGC).

Special Operations

Operations not specifically described in the preceding paragraphs will be flown occasionally. These special missions include air-sea rescue missions, anti-shipping strikes, and leaflet drops.

AIR-SEA RESCUE. Air-sea rescue procedures will generally be prescribed by the local theater. When a pilot is down, an accompanying pilot must immediately notify existing rescue facilities. Other pilots should orbit the distressed pilot while transmitting his position to controlling agencies. Consideration must be given to reaching the altitude necessary for line-of-sight transmission to the control facilities, as well as to making certain that visual contact with the downed pilot is not lost. Should a situation arise where it becomes necessary to strafe enemy troops or civilians attempting to capture the downed pilot, chances of eventual success of the rescue should be considered, since the pilot may be executed immediately if the rescue is abortive. Such contingencies are best covered prior to flying a mission, and in many instances the proper decision may be prebriefed. Each pilot engaged in combat flying should be well indoctrinated in rescue procedures and equipped with escape and survival gear, including small arms and appropriate rank insignia. It may save his life.

SHIPPING STRIKES. Strikes against lightly armored vessels with no escort present little difficulty. Low-level or skip bombing attacks with 1000-pound GP bombs with 4- to 5-second delay fuzes are effective. Bombs should be released so that they will strike the water and ship at practically the same time. Recovery should be made over the vessel and evasive action taken until out of range.

Attacks on lightly armored vessels with small escort are conducted in approximately the same manner as those against vessels without escort, except that an attack should be launched against the escort ships simultaneously with the low-level attack on the primary targets. The escort vessels may best be attacked by dive bombing. Dive bombing attacks should be launched on the longitudinal axis of the ship. In skip bombing it is desirable to attack a ship from abeam. It should be remembered, however, that when shipping is attacked abeam the enemy can bear the most guns on the attacker.

Attacking a naval task force is the most difficult of all strikes against shipping, since such a force involves heavy fleet elements, including aircraft carriers, battleships, and heavy cruisers. After information on disposition, speed, and direction of cruising of the enemy task force has been secured, targets should be assigned elements of the attacking air effort. The armament carried will vary with the number and type of ships in the enemy task force. Consideration should be given to the fact that a hostile task force usually maintains a large CAP. In pressing the attacks, one portion of the attacking force will normally be assigned to combat the

CAP; the balance will be used in coordinated attacks against the vessels. Care should be taken to employ a maximum number of aircraft against the target simultaneously to saturate the enemy's defense. Regrouping must be accomplished out of range of enemy fire.

LEAFLET DROPS. Leaflet drops of psychological warfare material by fighter or fighter-bomber aircraft may be necessary because of nonavailability of other type aircraft, or as required by special situations. Such material generally takes the form of propaganda leaflets or other printed material contained in special bombs, external tanks equipped with discharge doors, or containers released from JATO tubes. Such missions create no special problems other than accurate target location.

BASIC TECHNIQUES

Knowledge of Capabilities and Limitations of Equipment

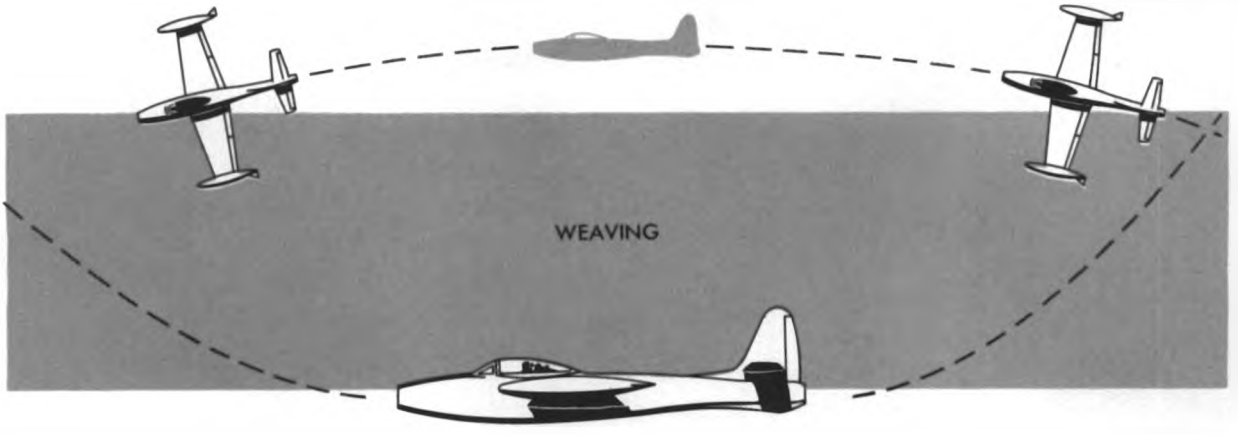
Basic to all other techniques known to flying is the thorough knowledge on the part of each individual pilot of the capabilities and limitations of the equipment both he and the enemy use. Familiarity with the aerodynamic characteristics of the airframe, the peculiarities of the engine, and the intricacies of the armament system has become increasingly more important as we've moved into the jet, sonic, and supersonic age.

Even with all the mechanical thinking devices incorporated in the modern airplane, there is no substitute for the pilot's brain and common sense. It is not enough that the pilot merely follow the indicators on the instrument panel that tell him when to fire, when to pull out, when to break, and so on; he must be able to fall back on pure, basic flying skill in the event these complicated systems fail. He must be quick to recognize malfunctions in his equipment and analyze their seriousness to determine if he must abort the mission or can proceed by using an alternate technique. A single abort may jeopardize the entire mission and those that are not completely justified are unacceptable. On the other hand, the loss of a costly airplane and crew because of faulty analysis of a malfunction is just as effective to the enemy as if the plane was destroyed in actual combat. By exploiting the strong points of his equipment against the known weak points of the enemy's, the fighter pilot is often able to equalize an otherwise superior enemy force.

The following discussion on basic techniques is, of necessity, very broad. For security reasons it is impossible to explain what effect each piece of present or projected equipment will have on the techniques involved. The trend of increased automatic devices aimed at eliminating the human error factor is being methodically pursued; however, as implied above, the pilot must "master-mind" such equipment, place his airplane in their area of effectiveness, respond to their instructions, quickly recognized when these instructions are erroneous, and be capable of accomplishing his objective if the automatic features fail completely.

Formations

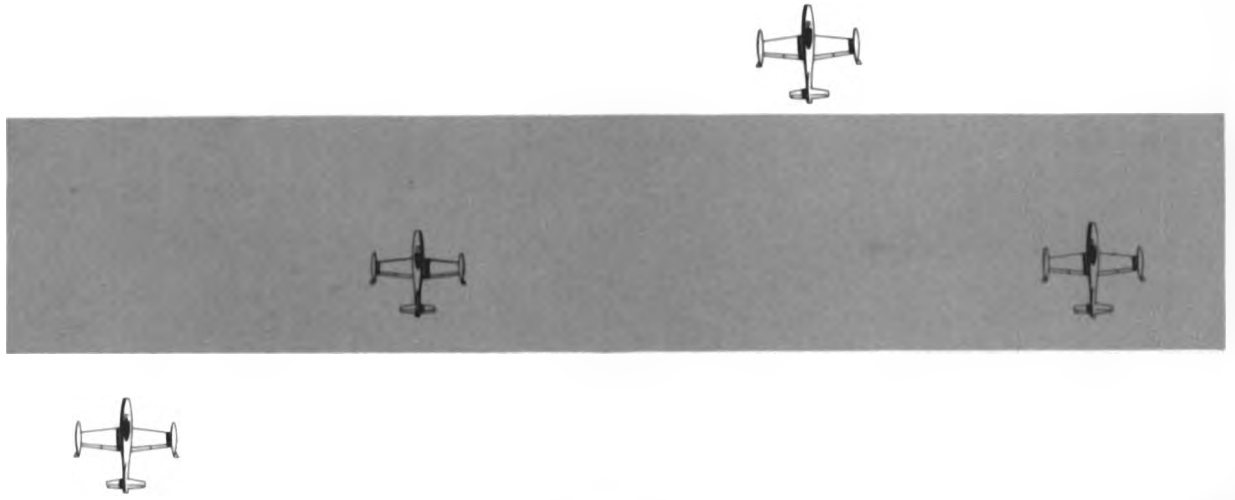
Combat formations of fighter and fighter-bombers must possess the characteristics of maneuverability, flexibility, mutual support, ease of control, and ability to readily switch from defensive to offensive employment. Specific aircraft performance capabilities may alter formation techniques but should never justify violation of these characteristics.



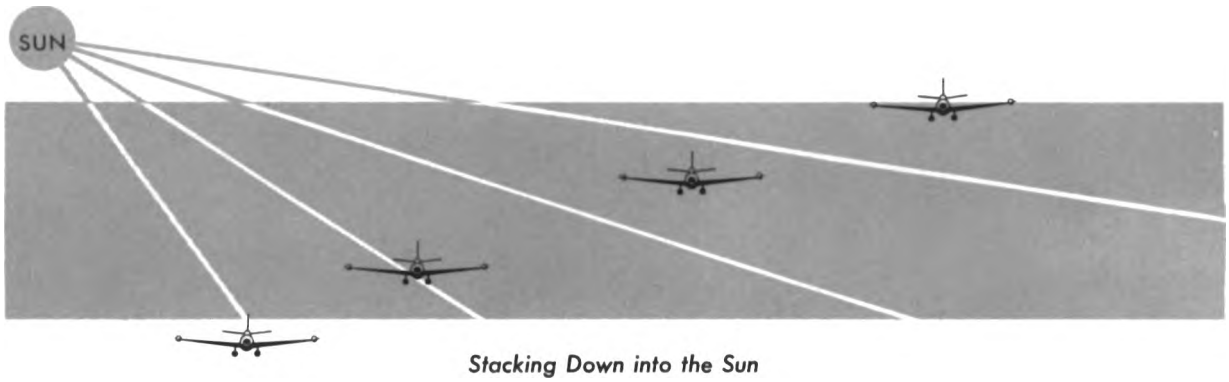
Two Ship Defensive Formation

The two-ship element is the basic fighter formation. In this formation individual aircraft support one another. The leader of the element should be the more experienced pilot and is generally regarded as the offensive portion of the element, while the wing man is the defensive partner. The two-ship element should be regarded as the smallest form of combat unit; under no circumstances should it be divided. The wing man's position will be dictated by the type of mission and aircraft he is flying, but generally, his lateral position will be from a point line abreast of his leader to 45° behind his leader. The horizontal distance from wing man to leader will be determined by the turning radius of the aircraft. Excellent defensive coverage can be obtained by weaving as illustrated above.

The next larger unit is a flight, which consists of two elements supporting each other. As in the case of the element, the more experienced man is designated as the leader. These two elements function the same as individual aircraft in a single element and afford each other the same advantages of mutual support and mass firepower.



Typical Offensive Formation



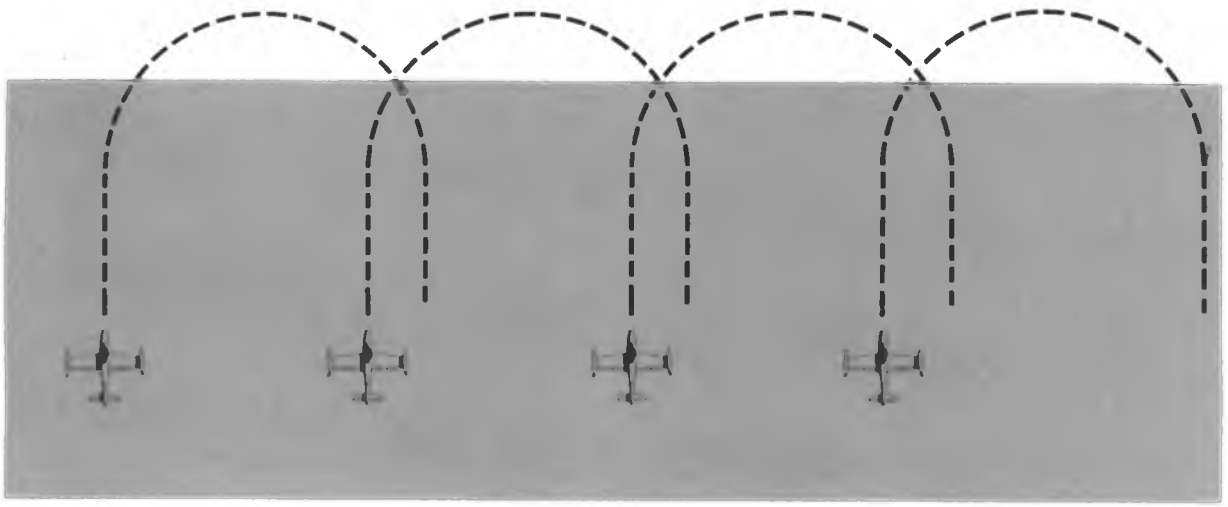
Stacking Down into the Sun

Two four-ship flights comprise a section, with each flight supporting the other in the same manner that elements are mutually supporting in a flight. A squadron consists of two sections, and a group consists of two or more squadrons.

Vertical positioning of units greater than elements is determined by the sun, with the supporting unit down sun of the leading element and exercising an altitude advantage. This enables the defensive unit to cover the rear quarter of the offensive unit without interference by the sun.

Combat formations fall into two general categories, offensive and defensive. In defensive formation, frequently all elements or units fly as close to line abreast as possible to enable each to cover the vulnerable rear quarter of the other. Maneuverability is reduced in defensive formation, but this should be of small concern, since routes to and from a target require very little turning. Line-abreast formation also lends itself to the defensive 180° break, illustrated below, if the formation is attacked.

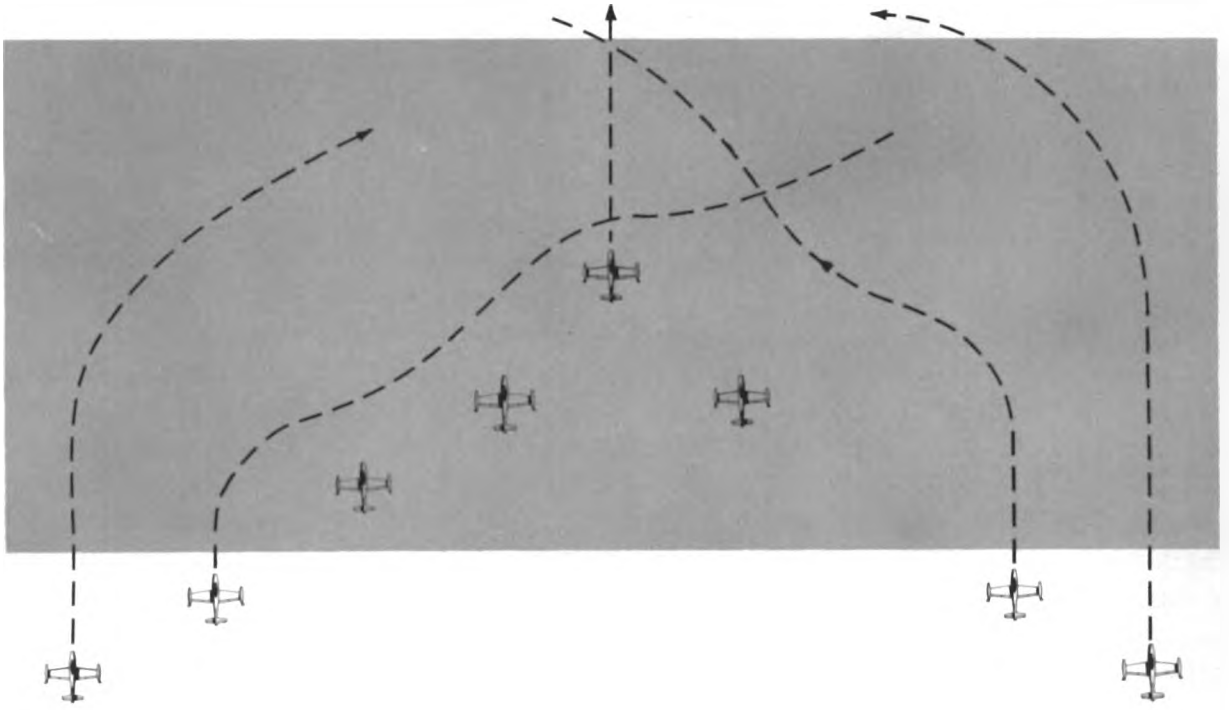
Offensive formation is used when a flight is in the target area or engaged in attack and



(1) BANDIT IS SIGHTED AND POSITION CALLED

(2) SIGHTER HAS CONTROL OF BREAK UNTIL FLIGHT LEADER ACKNOWLEDGES BANDIT. IF FLIGHT LEADER DOES NOT ACKNOWLEDGE SIGHTER WILL CALL BREAK.

Typical 180° Defensive Break



Coordinated Attack

is required to perform turning maneuvers to accomplish its mission. In offensive formation, wing men in elements and flights drop back to 45°, where they may enjoy a maximum of flexibility and maneuverability. Lagging should be avoided in combat formation because this deprives the individual of the benefits of mutual support and coverage and weakens the combat formation.

Close formation is generally conducted in the familiar four-ship, finger-tip formation or in echelon, with aircraft maintaining wing-tip clearance. Close formation is used for assembling formation, weather penetration, night formation, landing patterns, or at any other time when a flight or squadron commander deems it necessary to restrict his aircraft to a small area. Close formation imposes restrictions upon flexibility and maneuverability. While in close formation, flight commanders must conduct maneuvers as smoothly as possible.

Squadrons and Group Form-ups and Let-downs

To form a squadron or group of jet aircraft, it is best to attempt to join up en route to the target. Whenever possible, a form-up straight on course by utilizing differences in throttle settings should be attempted, allowing a distance gain on course.

For on-course form-ups, all squadrons participating in the mission must be briefed on split-second timing regarding starting engines and take-off priorities. Whenever possible for maximum-range missions, aircraft should be parked as close to the take-off runway as tactical considerations permit.

All available runways should be utilized on take-off. Under no-wind or light wind conditions, the squadrons may use opposite ends of the runway for coordinated take-offs. Where large numbers of aircraft are involved, aids such as pyrotechnic signals and flagmen should be used. The take-off interval should be reduced to a minimum consistent with runway conditions and loading of the aircraft.

It is highly undesirable to have squadrons or groups orbit the home base if fuel is critical to the mission. To expedite the form-up, crews should be briefed carefully as to air speeds and throttle settings. On the return route to base, squadrons should again break down into flights, attaining flight separation through power settings, in order to conduct the individual flight landing patterns. This should be done at cruising altitude; excessive fuel consumption makes low-altitude flying for large formations impractical.

Weather Flying

WEATHER PENETRATION. Weather penetration techniques will, of necessity, vary to meet conditions. A recommended basic technique for accomplishing penetration is: If only four aircraft are to penetrate the weather, normal four-ship, finger-tip formation is used. The flight leader sets the proper climbing speeds, and when assured that the flight is in position proceeds to penetrate weather on an established heading. Close formation is maintained until the flight breaks out in the clear.

If two or more flights are to penetrate an overcast the lead flight should maintain the base heading while remaining flights fan out on 15° headings from the base heading for one minute before resuming the base heading. Base heading and air speed should then be flown until the squadron is in the clear.

WEATHER LETDOWN. Weather letdown is accomplished in a manner similar to weather penetrations. The formation leader reduces throttle to a predetermined setting and proceeds to let down on a base heading. Generally, letdowns are flown at predetermined air speeds for given altitudes. When low altitudes are reached, the rate of descent is reduced until the flight breaks out in the clear. If more than one flight is making a letdown, unit procedures insure adequate spacing between flights, such as the flights fanning at 15° for one minute prior to resuming base heading and air speed. Spacing between flights may be accomplished by varying air speeds or altitudes.

There are several letdown procedures which can be used, depending on local conditions. The following procedure is suggested if it is impossible to execute a straight-in letdown. The flight or flights should pass over the station homer at an altitude of approximately 20,000 feet, or 500 feet above the tops of clouds, on a reciprocal course plus 20° from inbound heading. Immediately after passage over the station, dive brakes should be extended, throttle reduced, and a constant rate of descent or constant air speed and power setting started. A standard-rate descending turn should be made when the flight reaches a point on the outbound heading of one-half the starting altitude plus 2,000 feet. The letdown then continues inbound, with aircraft maintaining a constant air speed and rate of descent until minimum altitude is reached.

Prior to any mission, participating pilots must be briefed on the instrument procedures within their unit.

Navigation

FLIGHT PLANNING. Precision flight planning is essential to accurate navigation in jet aircraft. This is particularly important when long-range missions are flown over enemy territory without radio navigation aids and with no positive assurance that unfavorable weather will not be encountered. Accurate winds-aloft information is necessary and the compression factor must be introduced into the true air speed computation.

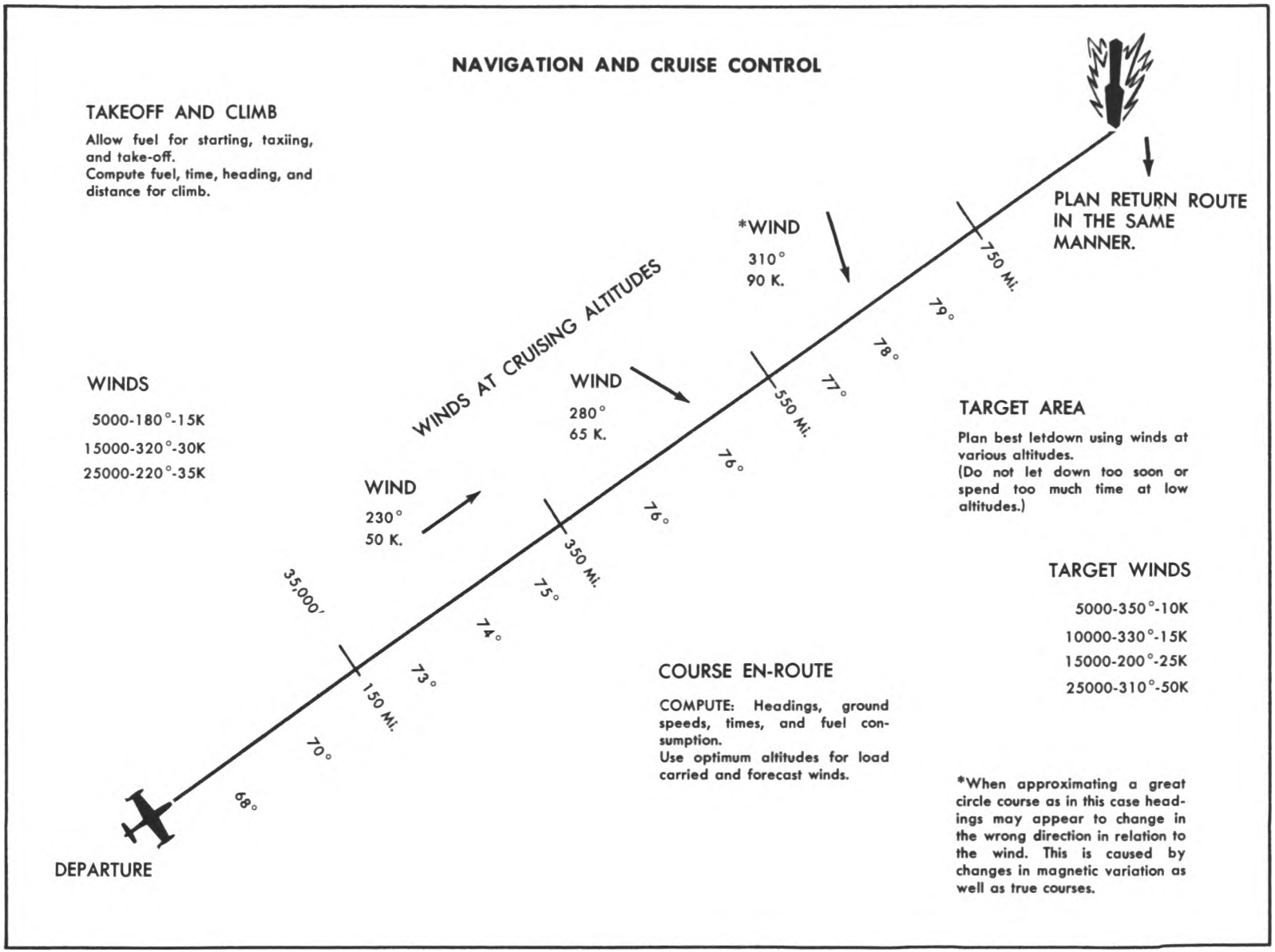
The recommended method of flight planning is to precompute all headings, altitudes, speeds, power settings, and fuel consumption. This is best done by breaking the flight path into segments approximately 200 miles long. Forecast winds should be applied to each 200-mile leg, and new headings should be computed for each part of the flight to approximate a great circle route. The assistance of a rated pilot-navigator is recommended for establishing flight planning procedures.

When operations are conducted in the same geographical area over a period of time, pilots become familiar with the time and distance data under local wind conditions and carrying various munitions loads. With this knowledge, they find it easier to navigate by pilotage and dead reckoning. Return from the target presents little problem if adequate radio aids are available. These aids may be either low-frequency directional homing beacons or DF stations. It is desirable in jet operations to have an adequate homing beacon or other aid located at the home base. Some older types of DF equipment are unreliable inasmuch as reciprocal bearings may be given to the pilot. However, an experienced flight leader will conduct his letdown to home base using time and distance, relying on DF for assistance only. Pilots of jet aircraft must be thoroughly familiar with, and be proficient in, dead reckoning methods of navigation.

USE OF MAPS. Use of maps is a simple but vital technique with which all fighter and fighter-bomber pilots must be familiar. A gridded-type map, such as one based on the Universal Transverse Mercator (UTM) system, and/or the Geographical Referencing System (GEOREF), furnishes the most efficient method of identifying targets. Such a map is especially helpful for operating over foreign terrain where geographical points have strange and unfamiliar names. The coordinate methods of target identification can be supplemented with radio transmissions between controllers and pilots. All pilots must be indoctrinated in the use of the various grid systems.

PINPOINTING TARGETS. Pinpointing targets presents no special difficulties. Maps to the target may be of small scale for ease in handling in the cockpit; however, it is desirable that the pilot have a large-scale map of the target area and aerial photographs when available. The easiest technique to employ is to locate the target in relation to some large geographical point, such as a town, lake, or river, and then steer a course to this reference point. Upon reaching the reference point, the pilot can then locate the target by pilotage. Pilots should practice pinpointing of targets on all routine navigational training flights.

CRUISE CONTROL. Cruise control is an important factor in jet aircraft operation. Because of high fuel consumption at low altitudes, optimum range is gained at high altitudes to and from the target area. Altitude should be maintained until the target area is definitely identified. Letdown is then made at high air speed with reduced throttle. After


NAVIGATION AND CRUISE CONTROL
TAKEOFF AND CLIMB
Allow fuel for starting, taxiing, and take-off.
Compute fuel, time, heading, and distance for climb.
PLAN RETURN ROUTE IN THE SAME MANNER.
*WIND
310°
90 K.
WINDS AT CRUISING ALTITUDES
WIND
280°
65 K.
WINDS
5000-180°-15K
15000-320°-30K
25000-220°-35K
WIND
230°
50 K.
35,000'
150 Mi.
350 Mi.
550 Mi.
750 Mi.
68°
70°
73°
74°
75°
76°
76°
77°
78°
79°
DEPARTURE
TARGET AREA
Plan best letdown using winds at various altitudes.
(Do not let down too soon or spend too much time at low altitudes.)
TARGET WINDS
5000-350°-10K
10000-330°-15K
15000-200°-25K
25000-310°-50K
COURSE EN-ROUTE
COMPUTE: Headings, ground speeds, times, and fuel consumption.
Use optimum altitudes for load carried and forecast winds.
*When approximating a great circle course as in this case headings may appear to change in the wrong direction in relation to the wind. This is caused by changes in magnetic variation as well as true courses.

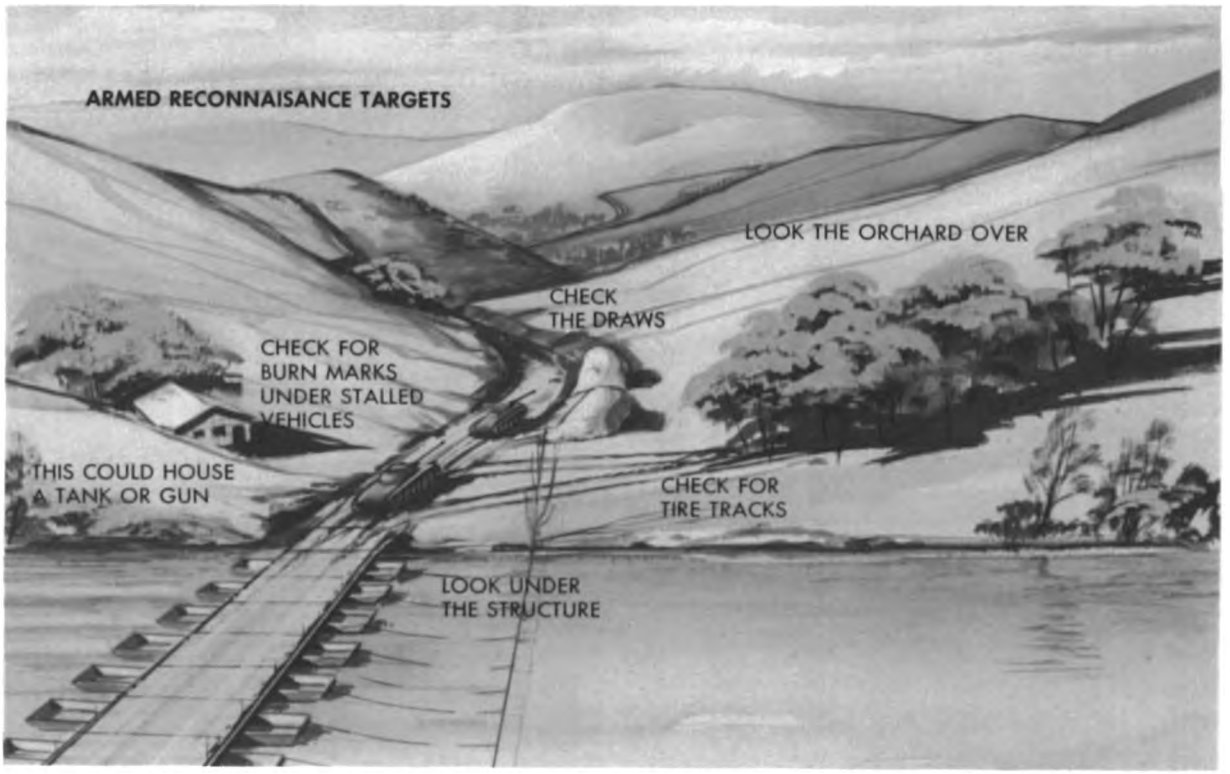
munitions are expended, the flight should re-form as quickly as possible and climb back to altitude. It is a common practice for flight commanders to call out the number of passes remaining to be made on the target to alert their flights for an impending form-up. Time lost in re-forming a flight for weather penetration may well cost the flight a missed approach reserve at home base. Flights returning from missions with low fuel reserves must be constantly aware of their positions through time and distance, pilotage, or electronic aids, so that a straight-in descent may be made to the home base. When flights are unsure of their positions, they must retain altitude until it is imperative that a letdown be started. The principle of cruising at higher indicated air speeds into the wind and lower indicated speeds with a tail wind is important in gaining maximum range.

Camouflage Detection

Camouflage detection is a necessary art because you may expect the enemy to be skillful in his use of camouflage and to employ it extensively. This is especially true if the enemy does not have air superiority and is therefore subject to air attack. Concealment then becomes an effective and necessary defense measure.

If an area is suspected of containing enemy troops, vehicles, or supplies, flight commanders should investigate the area at an extremely low altitude. The best technique is to look ahead of the aircraft and attempt to detect unnatural shapes, breaks in contours of houses, false haystacks, and any obvious color contrast. The pilot should look for all known forms of camouflage. If he suspects that enemy equipment is hidden in haystacks or houses, the pilot should direct a concentrated burst of gun fire into them and observe the results. Generally, if the hay or house contain vehicles or POL supplies, the fire will burn off the protective covering and the target can be identified. If vehicles or equipment is hidden between houses or beside houses, a definite change in contour and color contrast can be detected. If vehicles have been driven into houses, the fresh appearance of replaced walls or protrusion of larger vehicles will indicate this. If vehicles have been disguised as haystacks, telltale tracks may often be observed leading to the stacks. Ravines or dry river washes are also favorite hiding places of vehicles and supplies. Although it is difficult to detect tracks leading into ravines, presence of enemy equipment is usually indicated by unnatural mound shapes at the ends of the ravine.

Detection of vehicles in heavily wooded areas, especially in the summer, is extremely difficult because of the dense foliage. Generally, the enemy will not use additional camouflage in this case, since it is virtually impossible to detect the vehicles from above. The pilot must fly low enough to look under and through the trees to detect the enemy. Another likely place for camouflaged vehicles is immediately beside a low cliff. Any unusual mound of freshly cut foilage should be investigated and, if necessary, fired into. Other camouflage strategems include parking good vehicles among destroyed vehicles and burning a spot upon the ground with gasoline and then driving a good vehicle onto the blacked-out spot. A wheel may be removed so that, from the air, the vehicle appears to have been strafed, burned, and destroyed. The condition of the windshield and the tires usually indicate the condition of the target. Vehicles may be driven off the shoulders of the road and tilted at unusual angles so that, from the air, they appear to be destroyed.



Locating Targets

If vehicles are suspected of still being intact, a short burst should be fired into them and results observed. Usually a live vehicle will burn when hit by a concentrated burst of machine gun fire.

The enemy may cover his vehicles with heavy foliage so that, when immobilized, they will appear to be bushes growing next to the road. Any unusual shapes of this type should be fired into and results observed. This type of camouflage can sometimes be detected through the color contrast with the other foliage in the immediate area. If the enemy becomes careless and fails to replace his camouflage daily, his efforts will be recognizable from the air.

Generally, enemy tanks are concealed in the same manner as lighter vehicles, but when caught on the open road a tank is capable of driving into a house, allowing the roof and the walls to collapse upon it and thus making successful air detection difficult. The most difficult part of the tank to disguise is its long, protruding gun barrel.

Enemy personnel are rarely seen unless they are running or in obvious defensive emplacements. It is almost impossible to detect enemy personnel who do not move and who attempt to camouflage themselves.

The enemy will sometimes confuse the situation by camouflaging dummy trucks, tanks, field pieces, and aircraft. Dummy installations are usually encountered in airfield strikes, where they are used to draw fire from valid targets. It is a general rule that the presence of dummy targets indicates valid targets some place in the immediate vicinity.

Vertical detection in the winter is difficult, since white canvas is often used to cover equipment and vehicles. However, tracks are very difficult to erase and low-level angular sighting detection can be accomplished.

Enemy gun emplacements and entrenchments are best detected from a vertical position and generally characterized by their distinctive geometric pattern.

To become camouflage-wise, a studied effort is necessary on the part of the individual. Having detected camouflaged targets several times, pilots will find it increasingly easy to do so on succeeding missions. Each pilot must be familiar with the various methods of camouflage before he leaves the ground and must make a definite effort to utilize that knowledge during his mission.

Air-to-Air Combat

Attacks on enemy aircraft are divided into several types according to the angles from which a pilot fires: head-on, front quarter, beam, rear quarter, and astern. With the increase in aircraft speeds and the resultant high rate of closure, front quarter and head-on attacks have become more difficult and are seldom used. In these attacks, the combination of fast decrease in range and fast increase in angle-off requires a rapid rate of turn in the curve of pursuit. The fire control and timing required makes front quarter and head-on attacks extremely difficult. The most common attacks are beam and rear quarter attacks.

When a fast target is being attacked at a range of 1500 feet or less with a high-speed fighter, the amount of turn required to follow the target increases very rapidly as the fighter closes and normally necessitates breaking off the attack after 1 or 2 seconds of fire. If, under the same speed conditions, the pilot plans the attack to arrive within range at a smaller angle off, the turn is not as tight, and firing time is longer.

In all cases, attacks should be planned so that degree of turn required does not exceed the limitation of the fire control system, aircraft, and pilot. Early detection of the enemy is extremely important because it gives the pilot an opportunity to assume the offensive, or, when necessary, the defensive. A fighter pilot is rarely shot down by an opponent whom he sees.

In aerial warfare, opportunities to destroy the enemy are at best matters of split seconds and no opportunity should pass unheeded.

In firing at an enemy aircraft, range is by far the most important factor in obtaining hits. In the excitement of battle, many pilots are tempted to fire out of range, carelessly expending ammunition which may be needed later and giving away their positions. Effective firing ranges for fighters vary, but generally lie between 500 to 1500 feet for aircraft, guns, and gunsights without radar ranging of the type used in World War II and Korea. A pilot who is capable of gaining these ranges at low deflection angles will more than likely score victories.

A thorough knowledge of the characteristics of enemy aircraft is necessary for successful air-to-air combat. Pilots should be familiar with the strong points of their own equipment, compared to the capabilities of all types of enemy aircraft which may be encountered. If the hostile aircraft has superior turning characteristics, it would be fool-hardy to engage the enemy in a turning fight. If the enemy is capable of outdiving friendly aircraft, it would be equally foolish to attempt to elude him by diving.

Destruction of German Plane During World War II

The most valuable asset fighter pilots possess is the ability to work as a team. Fighter tactics have frequently been compared to football and this has proven a very apt analogy. A well-coordinated attack and defense is as effective in the air as on the gridiron. It has been proven again and again in China, Britain, Africa, Italy, Germany, Japan, and Korea that teamwork and aggressiveness can destroy a numerically superior enemy, who in many instances was better equipped but poorly led. The intangibles of aggressiveness and courage cannot be illustrated, but their weight is felt and can never be discounted in air-to-air combat.

Flak Evasion

Successful flak evasion depends on the pilot's knowledge of flak and flak evasion. The more flak "know-how" possessed by an individual, the greater his probability of survival.

Flak has a twofold purpose: destruction of the attacking aircraft and distraction of the pilot to compromise his accuracy in delivering munitions.

Flak is grouped by type as light (small arms and automatic weapons, including 20 mm and 40 mm), and heavy (75 mm and above). Its intensity is classified as meager, moderate, and intense. Flak is further described as either inaccurate or accurate. Flak is termed accurate when it strikes the aircraft or bursts close enough for the pilot to feel the concussion. Flak may be aimed visually or by radar and may be delivered in barrage-type fire or by tracking. Flak evasion tactics vary and are flexible. Each pilot should be prepared to recognize and to analyze the type of flak he encounters, be thoroughly familiar with its capabilities, and be prepared to take the course that will minimize the effect of enemy fire and still be consistent with his assigned mission.

LIGHT FLAK. Light flak, consisting of small arms and automatic weapons fire, is usually encountered on close air support and armed reconnaissance missions. It is not easily detected, is relatively inaccurate, and does not possess the destructive power of heavier flak. Light, intense flak, such as in encountered when a flight is receiving counterfire fire from entrenchments, can best be avoided by high speed and a steep diving attack followed by a rapid pull-out to an altitude above effective range of the weapons (3000 to 4000 feet). Many flight leaders favor this type of attack whenever possible, since it reduces battle damage probabilities by minimizing exposure. The enemy may attempt to shoot down low-flying aircraft by simply having all troops fire rifles and automatic weapons, hoping that the aircraft will fly into the fire. It should be assumed that the striking force

will receive small arms and automatic weapons fire on all close air support missions, and attacks should be planned accordingly. All strike leaders should attempt to conduct their attacks so that recovery off the target and the major portion of the pattern is over friendly lines, reducing the chances of small arms damage and providing pilots of damaged aircraft opportunity to bail out over friendly surface forces. This is not easily accomplished, since firing passes are generally conducted away from friendly lines.

The 20 mm and 40 mm flak is usually more distracting than fire from smaller weapons, since its burst and trajectory are detectable. It is usually visually aimed fire, but it can be radar-controlled. It is considered by experienced fighter and fighter-bomber pilots to be the most effective of all flak because of its accuracy. Its effective ceiling is generally from 7000 to 8000 feet for 40 mm flak, and approximately 4000 feet for 20 mm flak.

Since it is aimed fire, the best defense against it is speed, change of altitude, and rapid changes of course, called "jinxing." Straight-and-level flight should not be conducted for any extended period. When targets which are well defended by grouped 20 mm and 40 mm flak guns are being attacked, all chandelle-like maneuvers should definitely be avoided.

Attack should be made at maximum firing speed from the combat hump, and break-off should be made at tree-top level until out of range of the defender's guns. This is particularly true of attacks against airfields, naval convoys, and similar targets where the striking force may successfully fly out of gun range.

However, some targets, such as industrial complexes and large supply and troop concentrations, are defended by area employment of all types of light flak weapons. Over such areas, low-level flight is running a gamut and will lead to maximum exposure of the striking force. Rapid changes of direction and altitude, and maximum speed, are recommended over such flak areas.

In all areas of intense light flak, saturation of the defense and coordinated attack should be employed whenever possible. Attacks on a column are normally made from the side because of the concentration of return fire sustained when running lengthwise over the column.

HEAVY FLAK. Heavy flak is usually encountered at altitudes above 12,000 feet. It may be visually aimed but in most instances is radar-controlled. It is designed primarily for defense against bombers and is generally employed in radar-directed computed type fire. The lengthy time of flight of the projectile makes it comparatively easy for fighters or fighter-bombers to evade by jinxing. Heavy flak is generally conceded to be the least effective of all flak against fighters.

FLAK SUPPRESSION. Flak suppression is aimed at the destruction and/or demoralization of flak crews and is accomplished as required by direct attacks against gun emplacements. An effective method is dive bombing with proximity-fused bombs. When a heavily defended target is anticipated, a portion of the striking force should be loaded with such bombs for attack against the defenses immediately prior to the attack on the actual target.

Gunnery Techniques

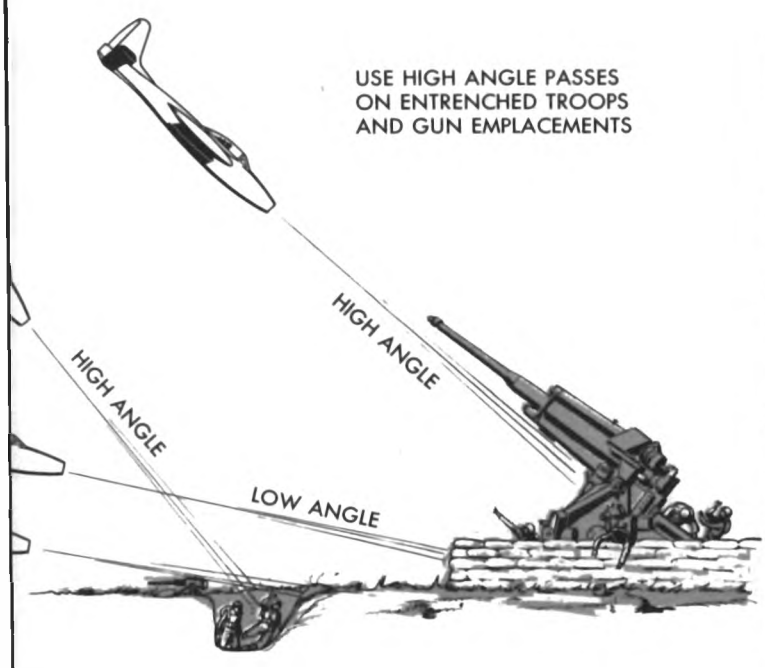
The basic weapon of fighter and fighter-bomber aircraft is the gun — either small-caliber cannon or machine gun. This armament may be used against a multitude of targets, from personnel and vehicles to loco-

motives, tanks and even small vessels. In all cases even when a concentration of targets is available, maximum effectiveness is achieved by concentrating on one target at a time. Attacks employing guns may be divided into two categories — high-angle and low-angle strafing attacks.

HIGH-ANGLE STRAFING. High-angle strafing is usually considered as that form of attack which employs a dive angle of 30° or more. The higher the angle of attack, the earlier the pilot must pull out of his dive. For this reason, high-angle strafing requires the pilot to fire at greater slant ranges (distance from aircraft to target) than in low-angle strafing. However, the higher the angle of attack, the less range enters into the sighting problem since bullet drop more nearly approximates the direction of fire. High-angle attacks are employed when terrain contours do not permit a low-angle attack, such as when a target is in a defiladed position. High-angle attacks may be initiated from any altitude, but generally will be entered from altitudes between 6,000 and 10,000 feet. Lower altitudes offer too little space for maneuvering and higher altitudes prohibit accurate spotting and assessment of ground targets.

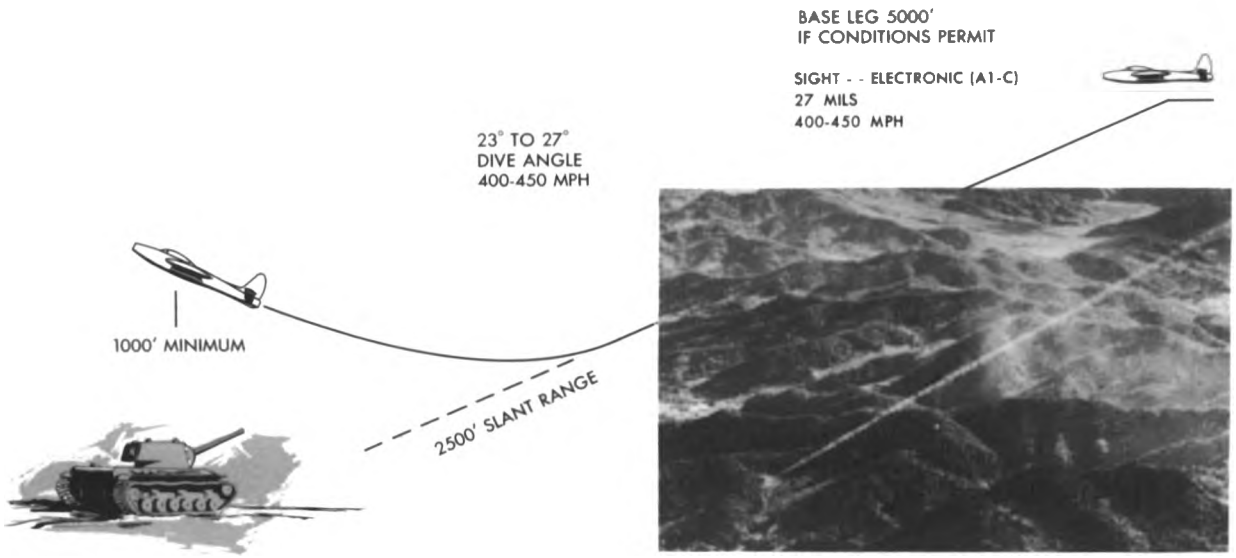
This type of attack is especially valuable for harassment and antimorale purposes against defensive ground positions. A well placed burst from a high altitude will sometimes rout a gun crew before the effective range for bombing or rocket firing is reached. Firing may be conducted from any time after the guns are initially brought to bear on the target until a pull-out must be effected.

LOW-ANGLE STRAFING. Low-angle strafing employs dive angles of less than 30°. Dive



angles between 15° and 20° are usually used. From an accuracy standpoint, these are probably the most favorable angles. These angles allow a good view and perspective of the target. They will normally clear all ground obstacles (such as trees) until the target is close and will allow the pilot to press his attack to within 600 to 1000 feet of the target, if the situation warrants. The most effective slant ranges are considered to be between 1000 and 1800 feet. As approach speeds are increased, the break-off distance must be moved back to allow for a pull-out. An aircraft traveling 400 mph will cover nearly 600 feet in one second — little enough time for a pull-out, even from a shallow dive.

The low-angle strafing pattern is best entered at 2,000 to 3,000 feet above the terrain. For best accuracy, the boresight speed of the aircraft, which is always well above the aircraft's cruising speed, must be reached in the dive to the target before firing is commenced. If firing is done before the boresight speed is reached, the bullets will fall short of the target, even if the target is within range. With a little practice, however, the alert pilot can adapt himself to each situation, and come to rely on a "sight picture" wherein he automatically corrects and adjusts for each detriment to accuracy. Practice and experience will soon equip him with the ability to judge wind, range, drift, speed, and feel of the aircraft to the extent that he can fire an effective burst into any target under most conditions. The pilot should remember, however, that in low-angle strafing, the aircraft will be flying at a slower and more vulnerable speed and will be subjected to the fire of enemy ground weapons and its own ricochets.



Rocketry Approach

Rocketry Techniques

Aircraft rockets are produced in a variety of shapes and sizes and vary greatly in their destruction potentials. As a rule, rockets are used on targets against which aircraft guns would have little or no effect — such targets as heavily armored tanks, railroads, buildings, and large vessels. Rocket firing techniques correspond to those used in strafing attacks. Because of their explosive and fragment-producing characteristics, rockets must be fired at relatively long slant ranges to allow the aircraft to pull up safely over the target and avoid blast or debris damage. This factor complicates the sighting problem.

Rocket firing technique may employ a steep dive angle to the target. This is primarily to impart better ballistics to a projectile with a comparatively slow velocity. With the higher diving speeds and larger turning radius (or distance required to pull out) of modern aircraft, however, steep angles necessitate firing at long slant ranges. Shallow dive angles (probably in the 23° to 27° region) allow the pilot to fire at a closer slant range. For example, an aircraft firing the 5″ HVAR (High Velocity Aircraft Rocket) from a 25° dive angle at 400-450 IAS can dive to within 2500 feet of the target.

Rocket fire is generally not as accurate as machine-gun or cannon fire. The pilot must practice diligently and conscientiously to become an expert with rockets. As a rule rockets with higher velocities afford better trajectories and ballistic characteristics. Furthermore, rockets utilizing the shaped-charge principle and the resultant requirement for less HE have less blast and shrapnel effect, allowing the rockets to be fired at shorter

slant ranges thereby increasing accuracy. The velocity of the 8 cm rocket, for example, compares favorably with that of the cal. .50 machine gun bullet. As velocities and ballistics of rockets continue to improve, machine gun accuracy may eventually be realized.

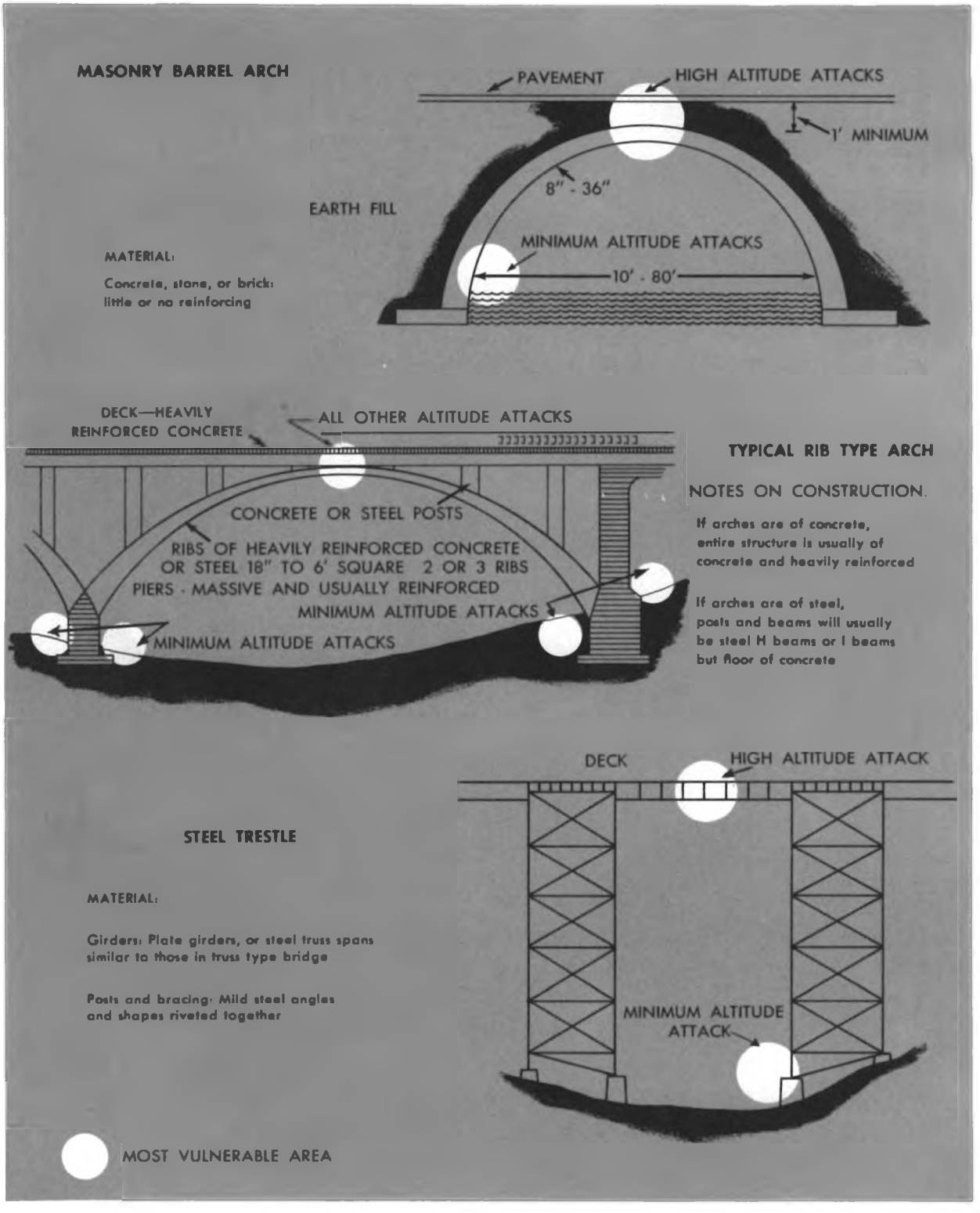
Bombing Techniques

Bombing techniques bring out the versatility of fighter-bomber aircraft to the utmost. General-purpose, fragmentation incendiary, napalm, and other type bombs, as well as propaganda leaflets and supplies, may be delivered by the fighter-bomber. In general, bombing attacks are directed against targets upon which rockets and gun fire would have little effect.

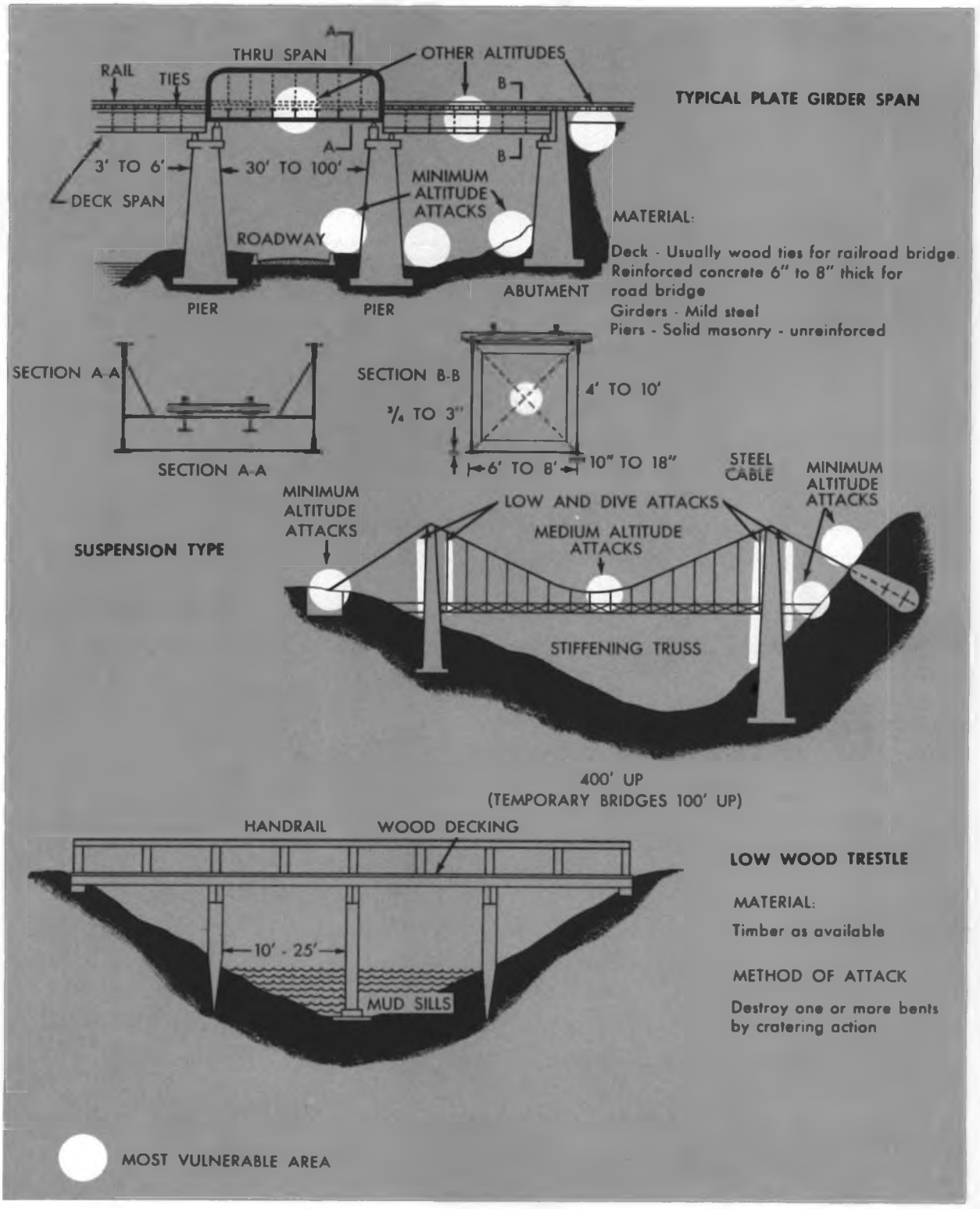
Of all the munitions discussed, bombs are the most difficult to place on a target with any consistent degree of accuracy. For that reason, targets requiring pinpoint accuracy are not as a rule desirable as bombing tarbets. Bombs can be employed effectively against buildings or factories, bridges, vehicle concentrations, hangars, airfields, marshalling yards, ships, barrack areas, supply dumps, docks, and similar targets.

DIVE BOMBING. Dive bombing is usually considered to be that form of attack in which the dive angle is 35° or greater. As in rocketry, the concept of dive-bombing techniques is for the pilot to make as nearly a vertical dive to the target as possible to minimize the effects of horizontal movement, gravity, and wind on the trajectory of the bomb. Dive-bombing techniques vary greatly with the type of aircraft. If the tactical situation (enemy fighters, flak, etc.) permits, the dive should be initiated from a slow cruising speed. A 35° to 45° dive angle is a good compromise between the extremely vertical and the shallow approaches. Bombs should be released as close to the target as possible consistent with safety. The bomb release point will also depend on the size and type of bomb, speed in the dive, maneuverability of the aircraft, and the enemy's ground fire capabilities. In any case, a pull-out at an altitude of at least 1000 feet over the target must be made to avoid damage from bomb blast and fragments. If the tactical situation permits, bombs should be released singly to give the pilot an opportunity to correct for any observed error.

With the advent of new, powerful weapons which can be delivered by fighter-bomber aircraft, consideration must be given to the technique of dive-bombing at much higher altitudes. The altitudes of release must be raised to correspond with the increased destructive power of the munition, to minimize the risk to the attacking aircraft. Although high-altitude techniques do not differ greatly from medium-altitude dive bombing, the many factors affecting accuracy are magnified as the release altitude is increased. It is generally conceded that the angle of dive must be increased to approximately 55° to preserve the required accuracy. With this increased angle and the resultant build-up in air speed, it is desirable that entry into the run be at the lowest safe air speed and that sightings and release be accomplished prior to reaching speeds which may affect aircraft control and accuracy. Because of the longer periods of wind effect on the trajectory of the bomb, it is important that as much information as possible on wind conditions in the target area be obtained. Only through extensive training in this technique will the required degree of accuracy be reached.



Vulnerable Areas — Bridges

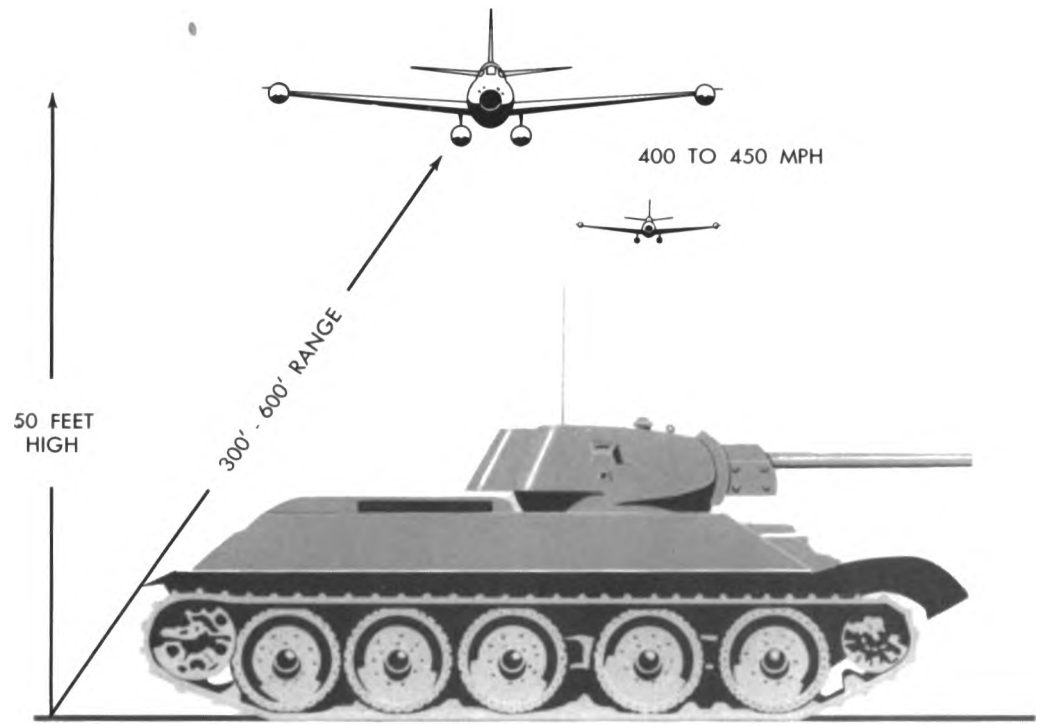


Vulnerable Areas — Bridges

MEDIUM-ANGLE BOMBING Medium-angle bombing — normally referred to as glide bombing — is used when low ceilings preclude dive bombing. Glide bombing is also an effective means of destroying long bridges, railroads, and similar targets where the point of impact is relatively unimportant except in deflection. It differs from skip-bombing in that a higher release altitude is used to avoid danger to the aircraft from bomb blast, since delayed action fuzes are not normally used.

LOW-ANGLE BOMBING. Low-angle bombing, or skip-bombing, techniques vary considerably from dive-bombing techniques. Skip-bombing attacks are generally carried out from a flight path parallel to the ground or from only a slight dive angle. The targets should have some vertical component to stop the bomb, such as the side of a ship, building, bridge, or railroad tunnel. The flight path at release point may come as close as within 50 feet of the ground. The bomb is released 300 to 600 feet short of the target, the distance depending on aircraft speed and altitude.

If the bomb is released too short, it may strike the ground or water and bounce completely over the target or explode beyond the target. In most instances, the ideal aiming point is that part of the target which joins the ground or surface of the water. Generally skip bombing is more accurate than dive bombing. However, it must be considered that aircraft making skip-bombing attacks are vulnerable to the enemy — both from the air and on the ground. Also, targets selected for skip-bombing attacks must contain certain properties in addition to the vertical component discussed previously. The bombs to be used for these attacks must be



Skip Bombing

delay-fuzed; otherwise, the attacking aircraft will most likely be destroyed or badly damaged along with the target. Since the bombs cannot be fuzed to explode upon contact with the target, they may pass through such targets as buildings and small ships and then explode seconds later.

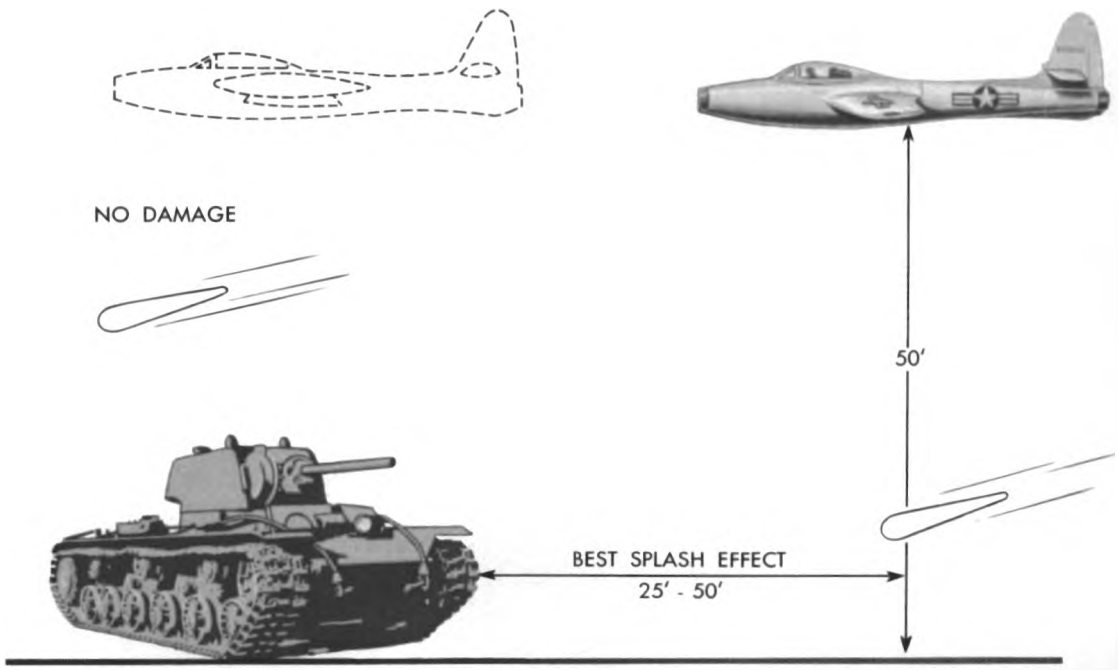
NAPALM BOMBING. Napalm bombing technique is similar to that used for skip bombing. The attack should be made at an altitude of approximately 50 to 100 feet at a fast air speed The release point will be determined by altitude and air speed, but in any case must be such that the tank will hit 25 to 50 feet short of the target to allow the flaming mixture to splash and spread over the target. Napalm is effective against such targets as tanks, armored vehicles, entrenched troops, wood structures, supply areas, and small towns or villages.

Special Techniques

SMOKE LAYING. Smoke may be used to cover and shield ground operations from the enemy or to obscure enemy gun positions during an attack within their range. Large troop movements across rivers may be aided through the use of smoke to conceal friendly movement and numbers. Attacks on shipping within a well defended harbor can also be aided by covering the hostile antiaircraft positions with smoke.

Smoke may be used on airfield strikes where flak installations are far enough from the aidrome to permit the attackers to cover the gun positions without obscuring the target. In this application, smoke laying makes it necessary to divert fewer aircraft to neutralize antiaircraft fire.

Smoke can also be used to screen movements of armored columns to protect ship-



Napalm Attack

ping, and for diversionary feints against enemy ground forces. Smoke is frequently used to identify ground targets on close air support missions by marking the exact location of a desired target. Smoke has many possibilities for tactical air, especially regarding the screening of hostile fire so that maximum firepower may be delivered on the primary target.

Since smoke becomes a part of the air mass upon release, care must be exercised in planning attacks. Smoke is most effective under no-wind or light-wind conditions, and should be released on the upwind side of the target area at an altitude of approximately 50 feet. Where ground fire is encountered, high air speeds are used during the release. Winds are usually lighter at dawn and dusk; therefore, best results are obtained during these periods. Wind conditions, relative humidity, and temperature-lapse rate dictate smoke persistency, and mission planning must include consideration of these factors.

CHEMICAL SPRAYING. Success in chemical attacks depends greatly on the ability to catch the enemy unprepared for such attacks. Spray attacks should be made at altitudes varying from 50 to 100 feet, and in the mass required to saturate a given objective. On occasions it may be desirable to precede the chemical attack against heavily defended areas by laying screening smoke over gun emplacements. It is often advantageous to conduct strafing attacks against personnel and equipment at the same time as the chemical attack to capitalize on the resultant confusion and panic of enemy personnel forced to utilize burdensome protective clothing and equipment.

Tactics for chemical spraying are similar to those for smoke laying; however, wind conditions and other factors affecting dispersion must be considered carefully when smoke is employed in proximity to friendly forces.

Briefing Techniques

Because of the nature of their work, it is imperative that fighter and fighter-bomber flights be briefed in detail prior to each flight. A fluid ground situation imposes frequent changes in bomb lines, code words, panel identification, and so forth. The costly result of any error committed by a flight commander demands that each pilot be current with the ground situation.

Enough time should be allotted so that the briefing can be conducted at an unhurried pace with ample time for questions. Briefings must be given in a concise and affirmative manner. Briefings being repetitious by nature, the briefing officers should make a special effort to retain the pilots' interest.

Briefing material is normally presented in the following sequence:

The commanding officer or formation leader presents:

- Target.
- Forces involved.
- Unit's place in over-all picture.
- Purposes of attack.

The intelligence officer presents:

- Target details:
  - Name, type, and location of target or targets.
  - Target importance and results of previous missions.
  - Target identification. Signal markers; check points, radar identification data, and so forth.
  - Bomb line (for close cooperation missions).
- Enemy capability:
  - Fighter defense.
  - Flak Analysis.

Evasion and escape procedures:
Issuing of E & E kits, purses, and maps.
Security measures.

The operations officer presents:
Designation of command and lead pilots.
Marshalling order.
Control point times and watch synchronization.
Take-off procedure and order.
Formation procedure and order.
Navigational plan, using route map and emphasizing control points and times.
Special bombing (strafing, rocketry, etc.) information.
Proposed plan of attack.
Emergency procedures.
Landing procedure and order.

The communications officer presents:
Radio security.
Explanation of new equipment and its use.
Navigational aids (stressing this point).
Radar countermeasures.
Recognition signals.
Communications operating instructions.
Call signs.
Other communications details.

The weather officer presents:
Over-all weather picture along route.
Special target weather information.
Condition on return.
Latest take-off conditions.

Special briefing when needed is supplied by:
Ordnance or armament officer.
Personal equipment officer.
Radar officer.
Ground liaison officer.
Officers from other participating air commands or units.

The commanding officer or formation leader presents:
Final instructions.
Special warnings.

The chaplain.

Briefing rooms should be situated so that pilots are not distracted during briefings. Strict attendance and promptness rules must be enforced and a high standard of discipline maintained throughout the briefing. Flights should have definite seating assignments and briefing aids should be placed on the seats before the pilots enter.

Each briefing room should be equipped with a ground situation map, a flak map, a weather board, an operations briefing board, a communications status board, and a special notice board. Since most of these boards contain classified information, provisions must be made to assure that the room or boards are secure. These boards should be air transportable, of permanent design, and kept clear and current.

The briefing room itself must be kept free of clutter, unnecessary information, and other distractions. If pilots are expected to absorb the information, the briefings must be serious in nature. In cases in which briefing officers relieve one another, it is mandatory that all use the same system, thus assuring continuity and completeness at each briefing. A well-briefed mission increases the effectiveness of a group. A confused pilot may be equally dangerous to friend and foe.

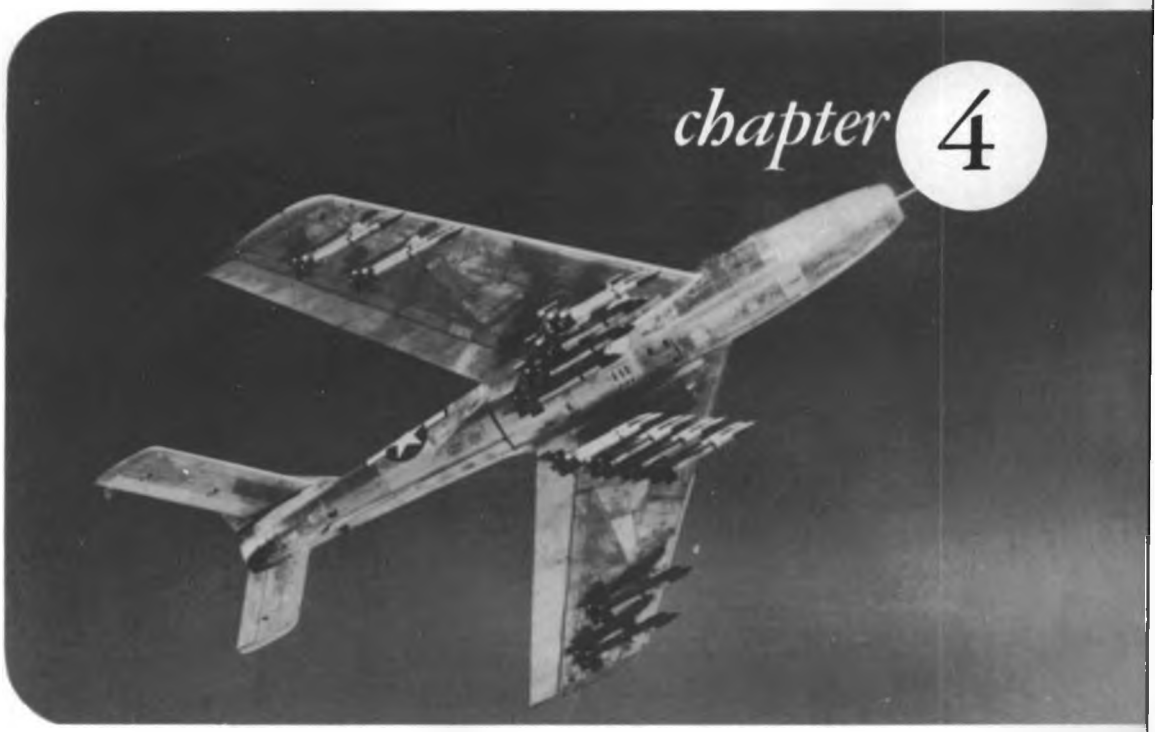
OPERATIONS FROM ADVANCED BASES

Athough the tactical aircraft is effective within its radius of action, this radius does not permit bases to be located long distances

from objectives. Maximum time over targets or extreme depth of penetration may be necessary. This normally requires that aircraft be based as close to the target areas as possible. Since ground action is often fluid in nature, tactical air units must possess a considerable degree of mobility. It is essential that all components of the tactical air organization, including supporting or service units, be able to move from site to site without disrupting the combat mission. Equipment should be designed with this in mind and, whenever possible, be air transportable.

Recent years have produced a remarkable increase in technical developments in airpower. Accompanying these developments are increased problems of maintenance, supplies, and personnel. Much of the effectiveness of tactical air operations hinges upon logistic support, which in itself is a difficult problem. The logistic demand for future operations must be accurately forecast and submitted in ample time to assure the uninterrupted operation of the group.

One of the most difficult problems encountered on advanced bases is obtaining the adequate storage, processing, and supply of fuel. The combination of high fuel consumption and frequent sorties presents a constant problem. Adequate portable fuel storage and filtering equipment must be maintained. There will always be logistic difficulties with fuel or any other type of supply which requires stockpiling and whose expenditure is regulated by combat needs. Such types of supplies range from heavy ordnance to relatively insignificant miscellaneous hardware parts for aircraft. The demands of mobility and flexibility increase logistic difficulties.



weapons used in tactical air operations

The weapons currently available in fighter or fighter-bomber type aircraft are placed in categories according to their functions as either penetration weapons or area weapons. The penetration-type weapon depends upon impact for its primary effect upon a specific target, although secondary area effect may also result. Area weapons are designed to achieve their effects primarily through blast over a fixed area, the size of which is determined by the type of weapon used. With a few special exceptions, which will be noted, all projectile-type weapons fall in the penetration category and all others in the area category.

The characteristics of the various penetration weapons are listed in the table on page 55. Recommended armament for various types of targets is listed on pages 56 through 59.

PENETRATION WEAPONS

Guns

CALIBER .50. There are two types of caliber .50 aerial machine guns presently in use, the M-2 and the M-3. The two types are generally the same and are identical in tactical application. The M-3 is the later of the two weapons and, because its high rate of fire is better adapted to tactical operations, is supplanting the M-2.

Both guns fire the same types of ammunition, and while there are many types of ammunition available only three are tactically significant. These three — the M-8 Armor-Piercing Incendiary (API), M-8 Tracer, and the M-1 Incendiary — are used in conjunction with each other. API bullets will pierce 5/8" armor plate at short ranges and also ignite any inflammable material which they contact.

The machine gun is the most versatile weapon the tactical pilot possesses. Although he may be expected to strike the target with only one out of five projectiles, the large number of rounds carried makes it possible for him to destroy most targets that he encounters.

The caliber .50 is effective against aircraft, personnel, light vehicles, light armor, and supplies. Despite all of its good characteristics, however, the increase in aircraft speed and the improvements in aircraft structural strength tends to reduce to some degree the future potential of this weapon. A projectile similar to but heavier than the .50, with an increased muzzle velocity, will enable pilots to fire at greater slant ranges and at greater deflection angles with an increase in destructive power.

15.2 MM. The 15.2 mm gun (T-130) is capable of much greater muzzle velocity and a higher rate of fire than the caliber .50. On the other hand, there is a slight decrease in the number of rounds that may be carried within a similar weight restriction. Compare the characteristics of the two guns as listed in the table at the right. The larger 15.2 mm projectile is capable of greater destruction than the caliber .50 projectile and should be more effective against enemy aircraft.

Cannon

The 20 mm cannon is capable of firing either high-explosive incendiary or armor-piercing projectiles and is effective against the same type targets as the machine gun, particularly against locomotives, light tanks, and similar targets. It has more range and greater destructive power than the caliber .50 machine gun. Since the complete installation of the 20 mm cannon is measurably heavier than that of the caliber .50 machine gun, the number of guns mounted and amount of ammunition carried on any given aircraft is reduced.

Rockets

FIVE-INCH HIGH-VELOCITY AERIAL ROCKET. The 5" High-Velocity Aerial Rocket (HVAR), originally designed by the Navy as an anti-shipping device, has three component parts: the motor, the head, and the fins. The standard head weighs 45.5 pounds and contains 14 pounds of TNT. The rocket can be fuzed with an instantaneous nose fuze and/or a .015 second delayed base fuze. Selective fuzing is obtained in flight by manipulation of the arming switch in the cockpit.

The 5" HVAR, when provided with a standard high-explosive head using a BD .02 second delay fuze, has excellent penetrating power. One rocket so equipped will penetrate 4 feet of reinforced concrete. This rocket is also capable of penetrating medium armor and thick steel plate.

An alternate fuzing now being used is the variable time fuze. This fuze provides air burst against ground targets and has been proposed for air-to-air use. The air-burst feature provided by the variable time fuze places this type of rocket in the area-weapons class.

WEAPON	WEIGHT (Pounds)	LENGTH (Inches)	AMMUNITION			VELOCITY F/S	RATE OF FIRE (Per minute)	MINIMUM SLANT RANGE (Feet)
			TYPE	WEIGHT IN POUNDS				
				ROUND	PROJECTILE			
Machine gun, Cal .50 M-2	61	47	Ball M-2	.26	.100	2840	750-850	700
			API M-8	.25	.094	2946		
			TRAC M-21	.25	.100	2735		
			APIT M-20	.24	.087	2945		
			INC M-23	.23	.073	3455		
Machine gun, Cal .50 M-3	64.6	57	SAME AS FOR CAL .50 M-2				1150-1250	700
Machine gun, 15.2 mm T-130	150	72	TE6E2	.52	.164	3500	Confidential	700
Cannon 20 mm M-3	120	77.7	APT M-95	.57	.286	2720	750-850	700
			INC M-96	.57	.276	2750		
			HEI M-97	.57	.291	2720		
Cannon, 20 mm M-24	116	77.8	T61E1	.60	.228	3100	750-800	
Cannon, 20 mm T-160	150	72	T61E1	.60	.228	3200	Confidential	
Rocket, 5" HVAR	140	68				1350	1/10 sec	2500
Rocket, 8 cm (80 mm)	20.9	43.3	HE & AP			2400	per round	700

Comparative Characteristics of Penetration Weapons

	TYPE WEAPON	PRIMARY TARGET	SECONDARY TARGET
GUNS	Cal. .50 15.2 mm 20 mm	Aircraft Vehicles Personnel (entrenched and open) Light armor Locomotives	Road blocks — Gun emplacements — Buildings — Supply dumps — Small boats — POL
ROCKETS	80 mm	Tanks — Armored vehicles — Locomotives and rolling stock	Pill boxes — POL
	5" HVAR	Pill boxes — ships — Tanks — Gun emplacements — Concrete buildings and warehouses	POL — Runways and track cuts — personnel
BOMBS	GP	Hangars — Runways — Road and rail cutting — Bridges — Marshalling yards — Tank bivouacs — Buildings — Ships and shipping — Gun emplacements	Locomotives — Personnel — Vehicles
	SAP & AP	Warships — shipping Bridges — (steel and concrete) Buildings — (concrete reinforced)	As G/P when G/P is not available
	Napalm	Personnel entrenched — Tanks — Pill boxes — Road blocks — inflammable stores and buildings	Gun emplacements — POL — Grounded aircraft and hangars (where low level attack is desirable — POL — Vehicle convoys
	Frag	Convoys — personnel in open — Ground aircraft — Pontoon Bridges — Gun emplacements — Bivouacs — Hangars	Pontoon bridges — Supply stores and buildings
	Incendiary	POL — Steel or wood installations	

Recommended Weapon vs Target Selection

	WEAPON							
		PRIMARY		SECONDARY		TERTIARY		
	TYPE OF TARGET	TYPE	FUZE	TYPE	FUZE	TYPE	FUZE	REMARKS
AIR FIELDS	Hangars	500 lb GP 1000 lb	.1 N .025 T		Napalm (for low level)			G/P not rec. for low level since bomb will pass thru hangar before det
	Aircraft	Machine Gun		Small frags	Instant fuze	Napalm		
	Runways	G/P	.1 N .01 T or .025	SAP	.1 N .01 T	5" HVAR RXS	Impact	
	POL	G/P	.1 Nose Non delay tail	5" HVAR & Napalm		Incend.		
BRIDGES	Reinforced concrete of steel-rib or open-arch type	500 lb 1000 lb 2000 lb GP	Nose .1 Tail .01 (See remarks)	1600 lb SAP	.1 (See remarks)	None		For low level or skip 8 to 15 second delay, no nose fuze
	Concrete or Masonry	500 lb 1000 lb GP	Ditto	SAP	Ditto	Ditto		Low alt 1000 or 2000 lb bomb with 8- to 15-second delay, no nose fuze
	Pontoon	500 lb 1000 lb GP	.025 T .1 N	Heavy frag	Inst	Ditto		Low alt. 1000 lb GP 8 to 15 second delay (aimed at water approx 100' from target)
	Wood	500 lb GP	.025 T .1 N	1000 lb .1	.025 T GP	Napalm		Low alt 1000 lb with 8 to 15 second delay, no nose fuze

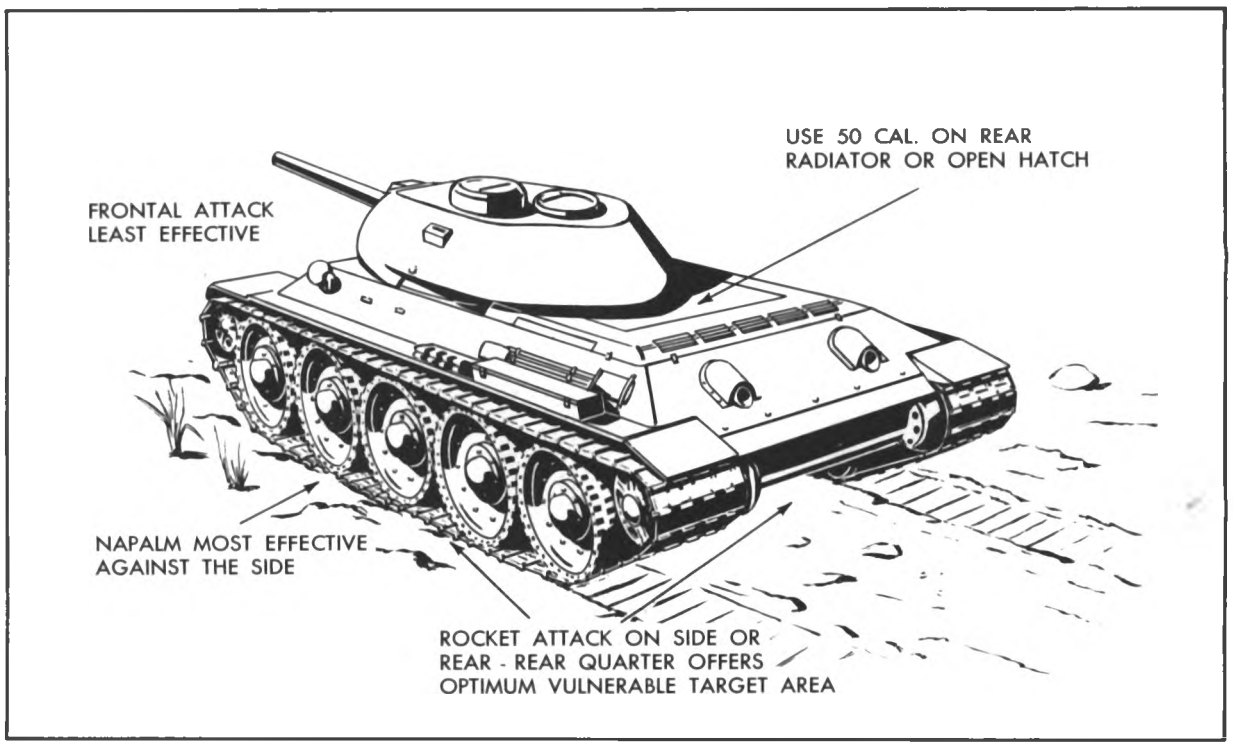
Recommended Target vs Weapon Selection

	WEAPON							REMARKS
		PRIMARY		SECONDARY		TERTIARY		
	TYPE OF TARGET	TYPE	FUZE	TYPE	FUZE	TYPE	FUZE	
BUILDINGS	Concrete and/or steel	G/P	.1 N .025 T	SAP	.01 T .1 N	5" HVAR		
	Wood	G/P	.1 N .025 T	Napalm		Incend.		
GROUP INSTALLATIONS	Gun installation	Napalm		Frag	Instant	Machine gun		
	Pillboxes	Napalm		5" HVAR		SAP	.025 T .1 N	
	Road blocks	Naplam		Frag	Instant	500 lb	Instant or VIT	
R. R.	Railroad yards	500 lb 1000 lb GP	.25 T .1 N					
	Locomotives	5" HVAR	Impact	Machine Gun		G/P Bomb	Impact	
	Track cuts	500 lb GP	Impact	5" HVAR	Impact			
ROADS	Roads, fills etc.	G/P	.1 Nose .025 Tail	SAP	.1 Nose .025 Tail			

Recommended Target vs Weapon Selection (continued)

	WEAPON							
		PRIMARY		SECONDARY		TERTIARY		
	TYPE OF TARGET	TYPE	FUZE	TYPE	FUZE	TYPE	FUZE	REMARKS
SHIPS	Ships (light)	500 lb 1000 lb G/P	.025 Tail .01 Nose	SAP		5" HVAR		Delayed tail fuze 4-5 seconds, no nose fuze, for low level attack
	Ships (warships)	2000 lb G/P	.1 N .025 T	1600 lb AP (Medium alt.)	No nose .08 Tail	10000 lb G/P		Delayed tail fuze 4-5 seconds, no nose fuze, for low level attack
PERSONNEL	Entrenched	Napalm		Machine gun				
	Open	Frag		Machine gun		Napalm		
	Bivouac	Frag		Napalm		G/P	V/T	
VEHICLES	Tanks	8 cm		Napalm		5" HVAR		
	Bivouaced tanks	1000 lb G/P	.025 Tail .1 Nose	Napalm		5" HVAR		
	Personnel & supply vehicles	API Machine gun		Frag	Instant	G/P	V/T	
	Veh. in convoy	Frag		G/P	V/T	Napalm & Machine gun		

Recommended Target vs Weapon Selection (continued)



Antitank Weapons

Ballistically the 5″ rocket has limitations. An over-all 7-to-10 mils dispersion error may be expected under perfect flying conditions with an experienced, well-trained pilot at the controls. This means an inherent error of 20 to 25 feet at the rocket's minimum slant range of 2,500 feet. Because of their weight, size, and shape, large numbers of rockets cannot be carried without a severe reduction in the range of fighter and fighter-bomber aircraft and a corresponding reduction in time over the target.

However, despite ballistic error and the limited number which may be carried, the 5″ rocket is an excellent weapon against small targets, such as tanks, vehicles, and gun positions and can be used to advantage against large targets, such as shipping, large buildings, warehouses, pill boxes, and railroad yards.

THE 80 MM ROCKETS. The Swiss-developed 8 cm rocket, now designated the 80 mm rocket, has only two component parts. This rocket has a greater velocity than the 5″ HVAR and carries a shaped charge. Since it is approximately 3 feet 7 ½ inches long and 3½ inches in diameter, and, since its weight does not exceed 21 pounds, it can be handled easily by one man. The electrical firing impulse used to ignite this rocket is transmitted through a solid connection rather than through the familiar pigtail that is used with the 5″ HVAR. The small HE charge permits the rocket to be fired at minimum slant ranges without fear of rocket blast damage to the aircraft. The minimum slant ranges at which it can be fired and the high velocities of which the 80 mm rocket is capable make it an accurate weapon, suitable for use against small targets, such as tanks and armored vehicles.

AREA WEAPONS

Demolition Bombs

Three standard types of demolition bombs are now in use by fighter-bomber units, namely, general purpose (GP), semi-armor piercing (SAP), and armor piercing (AP). The type and use of all demolition bombs are determined by the proportion of the weight of the explosive charge to the weight of the case. General purpose bombs are about 50% explosives, semi-armor piercing bombs are approximately 30% explosives, and armor piercing bombs are about 15% explosives. The general purpose bomb has the greatest blast effect, the armor-piercing bomb has the greatest penetrating effect, and the semi-armor piercing bomb has characteristics somewhere in between. Fuzes available for these bombs vary in time settings from instantaneous to 144 hours. In addition, hydrostatic fuzes are available for general purpose bombs, adapting them to antisubmarine use. The three types of bombs are similar in appearance.

GENERAL PURPOSE BOMB. General purpose (GP) bombs are available in varying weights from 100 pounds to 2,000 pounds. The wall thickness of GP bombs varies with their size. The case is thickened at the nose to gain extra strength for dropping the bomb "safe" and to provide extra stability for the threading that holds the fuze. The tail is also thickened to make up for the loss of metal resulting from the fuze bore. Charge or filler may be one of many kinds, depending upon the use for which the bomb was filled. TNT and Amotol are the most common fillers.

SEMI-ARMOR PIERCING BOMB. The semi-armor piercing (SAP) bomb, as well as the armor-piercing bomb, is designed to penetrate heavy concrete structures, deck armor or warships, and other similarly high-resistance targets. Semi-armor piercing bombs are available in 500-pound and 1,000-pound weights. They have heavy bases of special steel. About 30% of their weight is explosive D, a filler which is highly insensitive to great shock and permits the bomb to penetrate the target before functioning. SAP bombs are effective against all but the heaviest deck armor of modern battleships.

ARMOR PIERCING BOMB. Armor piercing bombs are designed to penetrate the heaviest of deck armor. Armor piercing (AP) bombs, containing about 15% in weight of explosive D, are available in 1,000-pound and 1,600-pound weights. Air Force AP bombs are converted models of the 12- and 14-inch seacoast mortar, deck, or armor-piercing projectiles. These converted bombs are called "limited standard." Standard AP bombs, designed by the Navy for joint use of the Air Force and Navy, will penetrate 6 to 7 inches of armor plate. Armor piercing bombs have solid noses and are sometimes fitted with armor piercing caps.

NEW FAMILY OF BOMBS. The impact of increased speeds on bomb delivery has necessitated development of a new family of bombs with improved aerodynamic and ballistic characteristics. The drag effect of externally stowed bombs of the type used in World War II and Korea is prohibitive to the ever increasing aircraft speeds. It is anticipated that the new series will permit sonic and supersonic speeds when carried externally and have ballistic characteristics compatible with proportionately increased release speeds. Little can be said about these bombs at this time because of security reasons and their limited state of development.

Fragmentation Bombs

"Frags" are designed to produce destructive effect against personnel and lightly

constructed targets. They are sometimes called antipersonnel bombs. Frequently a parachute is added to the bomb to retard its forward motion and to cause it to drop vertically. A fragmentation bomb, upon exploding, breaks into approximately 1,000 steel fragments each having the size and power of a caliber 30 slug. These fragments are scattered over an area of 600 yards at an initial velocity of 4,000 feet per second.

The fragmentation bomb consists of a thin steel tubular sleeve closed at each end by a heavy metal cap. A body of heavy steel bar stock, spirally wound, is assembled to the outside of the steel sleeve and provides the principal source of fragments when the bomb is detonated. Since the bomb depends entirely upon fragmentation for effect, the body is comparatively heavy while the explosive charge is just sufficient to rupture the case. As a rule, fragmentation bombs are smaller than demolition bombs. The lightest, a 4-pounder called the M-83 Butterfly Bomb, is packed in a bomb-shaped cluster. When these clusters open in mid-air, the wings of the M-83 unfold and rotate, retarding the fall of the bomb as it becomes armed mechanically.

Incendiary Bombs

There are probably more different types of incendiary bombs than of any other aerial weapon. The one most used by fighter-bomber aircraft and of greatest tactical significance is the napalm fire bomb. This improvised bomb has proved to be one of the most effective antipersonnel weapons presently in use. It is made up in the field using a droppable tank as container and being filled with a mixture of low octane (70-80) gasoline and 6% napalm powder by weight. The mixture is ignited by white phosphorous grenades, or sodium grenades if the bomb is being used on water. No burster charge is required, since good coverage is obtained by the splattering effect of dropping at high speed. This bomb is effective over an area of approximately 80 x 275 feet on flat ground and will burn from 3 to 15 minutes.

Smoke

Fighter-bomber aircraft are well adapted for the use of this passive device, and although its employment in the past has been extremely limited, it offers wide possibilities. Smoke is available in tanks for screening and in bombs and rockets for signaling and for spotting targets.

FUZING

The importance of proper fuzing cannot be overemphasized. In general, the detonation of bombs at the most favorable depth within the target is of more importance than the size of the bombs employed. For example, a typical machine shop consisting of a single-story 60 x 180-foot brick building 20 feet high, housing lathes, drills, planers, tools, and so forth, could well be 50% demolished (for practical purposes, 50% destruction is considered optimum for industrial structures), with 75% to 80% of the contents irreparably damaged or destroyed by a single, centrally placed 500-pound general purpose bomb detonating from 3 to 8 feet above the floor level. Conversely, the damage resulting from a 1,000-pound general purpose bomb detonated below the floor would not exceed that of the optimum-placed 500-pound bomb.

Unsatisfactory results are often obtained because of improper fuzing of bombs used against naval vessels, resulting in minimum damage being inflicted by direct hits with large bombs. Numerous examples can be

LOCATION	TYPE	REMARKS
NOSE	1. Impact or instantaneous	1. Normal fusing
	2. V/T or proximity fuse	2. Explodes 10′ to 250′ above ground. Has prop or vane generator to provide own power.
	3. Delayed nose fuse	3. Arming can be set at .1 — .025 — .01 delay.
	4. Mechanical time fuse	4. Clock type device. Very seldom used, except on cluster munitions.
TAIL	1. Delayed fuse	1. Arming can be set at .025 — .04 — .05 — .14 — .5 — 1. — 3. — 11. — 25. — 30. etc. to 144 hrs
	2. Mechanical time fuse (same as 4 above).	2. Clock type fuse — arming vane or pin armed (can be set for impact also)
	3. Hydrostatic (water)	3. Set for 25′ — 50′ — 75′ — 100′ — 125′ depth
SIDE	1. Hydrostatic (water)	1. Set for 25′ — 50′ — 75′ — 100′ — 125′ depth

Common Bomb Fuses Used by Fighter-Bomber Aircraft

cited of light topside damage caused by instantaneous fuzing where a slight delay would probably have caused extensive damage. On the other hand, excessive fuze delay in skip bombing has permitted complete penetration of the vessel, allowing detonation to occur at too great a distance from the hull to cause appreciable damage. Excessive fuze delay in dive bombing is rare in that detonation below the surface in the near vicinity of a vessel will more than likely be effective in severely damaging the hull.

Classification of Fuzes

INSTANTANEOUS FUZES. Instantaneous fuzes are used with all classes of demolition and fragmentation bombs against vehicles, light material, unprotected supply and ammunition dumps, and personnel targets.

NON-DELAY FUZES. Non-delay tail fuzes have a delay of approximately .003 second. They are used with instantaneous nose fuzes to insure detonation in the event of nose fuze failure.

DELAYED-ACTION FUZES. Delayed fuzing of .01, .025, .08, and .1 second are used to achieve optimum penetration prior to detonation on bombs employed against structures or resistant targets. The choice between fuzing for nose or tail detonation depends upon many factors, including fuze sensitivity, the nature of the target, and the fragmentation effects.

LONG-DELAY FUZES. Tail fuzes with delays of 4 to 5 seconds are used for minimum-altitude attacks on water-borne targets. Similar fuzes with 5- to 15-second delay are used for minimum altitude attacks against land objectives. Fuzes with various delays ranging from 10 minutes to 144 hours are employed to impede or discourage enemy occupation of the target area.

HYDROSTATIC FUZES. Hydrostatic fuzes, operated by water pressure, are employed with depth bombs to cause detonation at a predetermined depth.

PROXIMITY FUZES. Proximity fuzes (VT) are small radar fuzes which detonate in the air before reaching the target. The speed and altitude at the time of release determine the height above the target at which they will detonate, this altitude varying from 10 to 250 feet.

Minimum Release Altitudes

The minimum altitude for the release of instantaneous or short-delay fuzed bombs can be determined only for the tactical requirements of the particular situation. The minimum release chart on next page is intended therefore as an aid and not as a final criterion upon which to make decisions. Lower limits on the altitude of release are imposed by the fact that the fuze must be armed in the air, requiring a minimum air travel distance.

The dropping of bombs from minimum altitudes results in considerable risk to the aircraft flying the particular mission. The values listed under "Minimum Combat Altitudes" give the minimum altitudes at which there is an expectance of at least one perforation in 25 square feet of horizontal airplane area, in one out of every 100 bomb releases. This perforation has enough force to penetrate a 1-inch pine board and is sufficient to cause a casualty. This 1% risk may or may not be the risk which the air commander wishes to take.

It should be understood that large aircraft above a bomb burst present a large vulnerable area and should expect to receive an average of one perforation per run when just one bomb is dropped at the minimum altitude. The number of perforations to be ex-

MINIMUM RELEASE ALTITUDES

Bomb	Minimum combat altitudes [1 & 6] Fuze delay [2]		Minimum training altitudes [1 & 6] Fuze delay [2]	
	Inst. to 1 Sec	4-5 Sec [3] Water impact	Inst. to 1 Sec	4-5 Sec [3] Land impact
100 GP	500′	200′	1000′	100′
250 GP	500′	250′	1500′	100′
500 GP or SAP	650′	250′	2000′	150′
1000 GP or SAP	750′	300′	2500′	200′
2000 GP	850′	300′	3000′	200′
4000 LC [4]	1250′	.....	4000′	.....
20 Frag	500′	.....	800′	.....
23 Parafrag [5] M72	70′	.....	70′	.....
90 Frag	500′	.....	1000′	.....
260 Frag	650′	.....	2000′	.....
M47 or M76 (Incendiary, Smoke, or Chemical) Incendiary clusters	100′	.....	200′	.....
	Any altitude with respect to safety.			
350 Depth Bombs	500′	.....	1000′	80′ [7]
650 Depth Bombs	750′	.....	1500′	80′ [7]
Practice bombs with spotting charge	.....	.....	50′	.....
Practice bombs w/o spotting charge or inert loaded bombs	.....	.....	No restriction	No restriction

[1] In many cases the minimum altitude of release will be determined by fuze arming requirements. The altitudes listed will permit arming of the AN-M103 and AN-M100A2 fuzes at any release speeds. Bomb fuzes of the M103, M100, and M100A1 series must be prearmed to function at minimum combat altitudes, but will function at minimum training altitudes if released above 150 mph. The M112, M113, and M114 will arm 4 feet below the bombing airplane at 200 mph. Reference should be made to appropriate technical publications covering prearming.

[2] There are no safety restrictions imposed by blast or fragmentation on combat or training minimum altitudes when 8-15 second or 45 second delay fuzes are employed. Altitude restrictions imposed by other considerations, such as target height, fuze arming requirements, and the possibility of damage by ricochets, must be determined by the conditions of use.

[3] The 4-5 second delay fuze is designed primarily for use against water targets, and its use on land is not recommended if either 8-15 second or 45 second delay fuzes are available. The 4-5 second delay fuze may be employed for water impact without restriction for combat minimum altitudes. Use of 4-5 second delay fuze for training purposes is not recommended.

[4] Instantaneous fuzing only should be employed on the 4000 LC bomb.

[5] If the clustered M40 Parafrags are employed, release must not be lower than 100 feet at 250 mph.

[6] Bomb release in dive and glide bombing should be made such that the airplane has reached a point at or above the altitudes listed prior to bomb impact. Prearming of M103, M100, and M100A1 series fuzes will be necessary for dive bombing releases at these altitudes.

[7] This altitude will minimize to a practical degree the danger of ricochet from water. Generally the 325 and 350 lb flat nose depth bombs will not ricochet when dropped from altitudes greater than 80 feet and ground speeds of less than 200 knots (230 mph).

Minimum Release Altitudes

pected when several bombs are released at minimum altitudes is proportional to the number of bombs dropped.

In the interest of clarity, it would be wise not to speak of a "safe" altitude of release, but rather of an altitude of release which will give a prescribed risk, taking into account the area presented by the aircraft and the number of bombs dropped. The altitudes listed under "Minimum Training Altitudes" are those at which the distribution of fragments is so wide that the probability of serious injury to personnel is negligible. These altitudes are based on extensive tests and are considered safe for training purposes, although a theoretical risk from fragments does exist. It must be noted that the altitude of release is often dependent on the number of revolutions necessary (based on travel distance) to arm the particular fuze in use. This distance can be reduced by prearming. Instructions for prearming will be found in appropriate technical orders.

SPECIAL WEAPONS

For security reasons, detailed discussion of atomic and other special weapons available in the tactical air arsenal cannot be entered into in this manual. Information on these weapons may be obtained from other sources. It should be pointed out, however, that modern fighter-bombers are capable of timely, accurate delivery of these special weapons. This addition to its previously existing capabilities makes the fighter-bomber a truly versatile asset of tactical air.

However, despite this versatility, successful operations depend on the coordinated efforts of the entire tactical air team — the day fighters, all-weather fighters, interceptors, fighter-bombers, reconnaissance aircraft, tactical bombers, and night-intruders. With this potent force, the air commander has at his disposal the offensive and defensive means to direct his mission to successful completion.

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